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AN ESSAY Of the Great EFFECTS OF Even Languid and Unheeded MOTION.

Whereunto is Annexed

An Experimental Diſcourſe of ſome little obſerved Cauſes of the Inſalubrity and Salubrity of the Air and its Effects.

By the Honourable *ROBERT BOYLE*, Fellow of the Royal Society.

LONDON,
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Publisher.

'TIS *thought fit the Reader should be inform'd, That the insuing Tract (about the* Effects of Languid Motions) *was design'd to be a Part of the Author's Notes about the* Origine of Occult Qualities,

ties, *and ſhould have come abroad together with the Papers about the* Effluvia of Bodies *(moſt of which are already publiſh'd.) And accordingly it was printed ſeven or eight years ago: which Circumſtance is here mention'd, to give a Reaſon why ſeveral Particulars were omitted in the Body of the Diſcourſe, that will be found annex'd to the End of it. For theſe occurring to the Authour whilſt he curſorily read over the Tract it ſelf, when*

it was upon the point to be made publick, 'twas thought fit rather to ſubjoin them by way of a ſhort Appendix, *than to let any thing be loſt that ſeem'd pertinent to ſo difficult and unculti-vated a Subject, as That they belong to. The Reader is farther to be adver-tis'd, That of the* Three Preliminary Diſcourſes, *which the Authour inten-ded for Introductory Ones to What he deſign'd to ſay more particularly about the* Mechanical Origine or Pro-

Production of Occult Qualities, One *was concerning the* Relations betwixt the Pores of Bodies and the Figures of Corpuscles: *but that the great Intricacy and Difficulty He found in this copious Subject, made Him consent, That the* Discourse of Local Motion, *which should have accompany'd it to the Press, should be printed long before it. And those Papers about* Pores and Figures *having been for a great while out*

of

of the Author's Power, He now to gratify the Studious with something that may in their stead make up the formerly printed Essay a Book of a convenient Bulk, has put into his Hands what now comes forth, about some Unheeded Causes of the Healthfulness and Insalubrity of the Air: which being chiefly attributed to Subterraneal Steams, Subtile and for the most part Invisible, are as near of kin to the other Effluviums treated of in the Introductory

ry Diſcourſe, as is requiſite to keep the mention that is made of them in this Book, from appearing very incongruous.

AN

AN
ESSAY
Of the Great
EFFECTS
Of
Even *Languid* and *Unheeded*
LOCAL MOTION.

CHAP. I.

HOW ſuperficially ſoever the *Local Motion* of Bodies is wont to be treated of by the Schools, who admit of divers other Motions, and aſcribe almoſt all ſtrange things in Phyſicks to *Subſtantial Forms* and *Real Qualities*; yet it will become Us, who endeavour to reſolve the *Phænomena* of Nature into Matter

and Local motion, (*guided*, at the beginning of things, immediately, and ſince *regulated*, according to ſettled Laws, by the Great and Wiſe Author of the Univerſe,) to take a heedfull notice of its kinds and operations, as the true Cauſes of many abſtruſe Effects. And though the induſtry of divers late Mathematicians and Philoſophers have been very laudably and happily exerciſed on the nature and general Laws of this Motion; yet I look upon the Subject in its full extent to be of ſuch importance, and ſo comprehenſive, that it can never be too much cultivated, and that it compriſes ſome parts that are yet ſcarce cultivated at all. And therefore I am not ſorry to find my ſelf obliged, by the deſign of theſe Notes, (written, as you know, to facilitate the explicating of *Occult* Qualities) to endeavour to improve ſome neglected Corners of this vaſt field, and to conſider, Whether, beſides thoſe effects of Local motion which are more conſpicuous, as being produced by the mani-

manifeſt ſtriking of one body againſt another, where the bulk, &c. of the Agent, together with its Celerity, have the chief Intereſt; there may not be divers effects, wont to be attributed to Occult Qualities, that yet are really produced by *faint* or *unheeded* Local motions of bodies againſt one another, and that oftentimes at a diſtance.

But, before I enter upon particulars, this I muſt premiſe in general, (which I have elſewhere had occaſion to note to other purpoſes,) that we are not to look upon the bodies we are converſant with, as ſo many Lumps of Matter, that differ onely in bulk and ſhape, or that act upon one another merely by their own diſtinct and particular powers; but rather as bodies of peculiar and differing internal Textures, as well as external Figures: on the account of which ſtructures, many of them muſt be conſidered as a kind of Engines, that are both ſo framed and ſo placed among other bodies, that ſometimes Agents, otherwiſe in-

valid, may have notable operations upon them, becauſe thoſe operations being furthered by the Mechaniſm of the body wrought on, and the relation which other bodies and Phyſical Cauſes have to it, a great part of the effect is due, not preciſely to the external Agent, that 'tis wont to be aſcribed to, but in great meaſure to the action of one part of the body it ſelf (that is wrought on) upon another, and aſſiſted by the concurring action of the neighbouring bodies, and perhaps of ſome of the more Catholick Agents of Nature. This Notion or Conſideration being in other Papers particularly confirmed, I ſhall not now inſiſt upon it, truſting that you will not forget it, when there ſhall be occaſion to apply it in the following Notes.

There may be more Accounts than we have yet thought of, upon which *Local motions* may perform conſiderable things, either without being much heeded, or without ſeeming other then faint, at leaſt in relation to the

the conſiderableneſs of the Effects produced by them. And therefore I would not be underſtood in an excluſive ſenſe, when in the following Diſcourſe I take notice but of a few of the above-mentioned Accounts; theſe ſeeming ſufficient, whereto, as to Heads, may be conveniently enough referred the Inſtances I allot to this Tract.

And concerning each of theſe Accounts, I hold it requiſite to intimate in this place, that I mention it onely, as that whereon ſuch effects of Local motion, as I refer to it, do principally depend: for, otherwiſe, I am ſo far from denying, that I aſſert, that in divers caſes there are more Cauſes than one, or perhaps than two of thoſe here treated of apart, that may notably concur to *Phænomena* directly referred to but one or other of them.

To come then cloſer to our ſubject; I ſhall take notice, That among the ſeverall things, upon whoſe account men are wont to overlook or under-

value the efficacy of Local motions, that are either Unheeded or thought Languid, the chief, or at leaſt thoſe that ſeem to me fitteſt to be treated of in this Paper, are thoſe that are referable to the following Obſervations.

CHAP. II.

Obſervat. I. *Men are not uſually aware of the great efficacy of* Celerity, *even in ſmall Bodies, and eſpecially if they move but through a ſmall ſpace.*

WHat a rapid Motion may enable a Body to doe, may be judged by the powerfull and deſtructive Effects of Bullets ſhot out of Cannons, in compariſon of the Battering Engines of the Ancients, which, though I know not how many times bigger then the Bullets of whole Cannon, were not able to batter down Walls and Towers like Bullets, whoſe bulk compared with theirs is inconſiderable. Other examples of

of a like nature might be without impertinency alledged on this occaſion; but, becauſe the latter part of our Propoſition contains that which I chiefly aim at, I ſhall proceed to Inſtances fit to prove That.

I have ſometimes cauſed a skilfull Turner to turn for me an oblong piece of Iron or Steel, and placing my naked hand at a convenient diſtance to receive the little fragments, perhaps for the moſt part leſſer then ſmall pins heads, as they flew off from the rod, they were, as I expected, ſo intenſely heated by the quick action of the Tool upon them, that they ſeemed almoſt like ſo many ſparks of fire; ſo that I could not endure to continue my hand there. And I remember, that once asking an expert workman, whether he (as I had ſometimes done) did not find a troubleſome heat in the little fragments of Braſs that were thrown off when that metall was turning? He told me, that heat was ſometimes very offenſive to his eyes and eye-lids. And

when I asked, whether it was not rather as Dust cast into them, than from their Heat; he replied, that besides the stroke, he could sensibly feel a troublesome heat, which would make even his Eye-lids sore: And that sometimes, when he employed a rough Tool, that took off somewhat greater Chips, he had found the heat so vehement, that not onely 'twould scorch his tender Eye-lids, but the thick and hard skin of his hands: for proof whereof he shewed me in one of his hands a little blister, that had been so raised, and was not yet quite gone off.

And inquiring about these matters of a famous Artist, imployed about the finishing up of cast Ordnance, he confess'd to me, That, when with a strong as well as peculiar Engine he and his associates turned great Guns very swiftly, to bring the surface to a competent smoothness, the tools would sometimes throw off bits of metal of a considerable bigness, which, by reason of their bulk and their rapid motion, would be so heated as to burn

the fingers of the Country-people that came to gaze on his work, when he, for merriment ſake, deſired them to take up ſome of thoſe pieces of metall from the ground. Which I thought the more remarkable, becauſe by the Contact and Coldneſs of the ground I could not but ſuppoſe their Heat to have been much allayed. Not to mention, that I learnt from an experienced Artificer, that in turning of Braſs the little fragments of that metall acquire an intenſer Heat than thoſe of Iron.

I remember alſo, that, to vary the Experiment mentioned juſt before this laſt, by making it with a bodie far leſs ſolid and heavy than Braſs or Iron, I cauſed an Artificer to turn very nimbly a piece of ordinary wood, and holding my hand not far off, the powder, that flew about upon the operation, ſtruck my hand in many places with that briskneſs, that I could but uneaſily endure the Heat which they produced where they hit. Which Heat whether it were com-

mu-

municated from the little, but much heated, fragments to my hands, or produced there by the brisk percuſſion on my hand, or were the joint effect of both thoſe Cauſes; it will however be a good Inſtance of the power of *Celerity* even in very ſmall bodies, and that move but a very little way.

'Tis conſiderable to our preſent purpoſe, that by an almoſt momentany percuſſion, and that made with no great force, the parts, even of a vegetable, may be not onely intenſely heated, but brought to an actuall Ignition; as we have ſeverall times tried, by ſtriking a good Cane (of that ſort which is fit for ſuch Experiments) with a ſteel, or even with the back of a knife. For, upon this Coliſion, it would ſend forth ſparks of fire like a flint.

To the ſame purpoſe may be alledged, that, by but dextrouſly ſcraping good loaf-ſugar with a knife, there will be made ſo brisk an agitation of the parts, that ſtore of ſparks will

will be produced. But that is more conſiderable, which happens upon the colliſion of a flint and a ſteel: For, though Vitrification be by Chymiſts eſteemed the ultimate action of the fire, and though, to turn ſand or ſtones, though very finely poudered, into glaſs, 'tis uſually required that it be kept for divers hours in the intenſe fire of a glaſs-houſe; and though, laſtly, the glaſs-men complain, that they cannot bring flints or ſand to fuſion without the help of a good proportion of *Borillia* or ſome other fixed ſalt: yet both actuall Ignition and Vitrification are brought to paſs almoſt in a moment by the bare vehemence of that motion that is excited in the parts of a flint when it is ſtruck with a ſteel: For thoſe ſparks that then fly out, (as an Ingenious perſon has obſerved, and as I have often ſeen with a good Microſcope,) are uſually real and permanent parcels (for the moſt part globulous) of ſtone vitrified and ignited by the vehemence of the motion. And that *Mr. Hooke.*

this

this vitrification may be of the ſtone itſelf, though ſteel be a metal of a far more fuſible nature then a flint, I am induced to think, becauſe I have tried, that not only flints with ſteel, but flints with flints, and more eaſily pieces of Rock-Cryſtal between themſelves, will by colliſion ſtrike fire. And the like effect of colliſion I have found my ſelf in ſome precious ſtones, harder than Cryſtall. And afterwards inquiring of an ingenious Artificer that cuts Diamonds, Whether he had not obſerved the like, when Diamonds were grated on by the rapid motion of his mill? He replied, that he obſerved Diamonds to ſtrike fire almoſt like Flints; which afterwards was confirmed to me by another experienced cutter of Gems; and yet having made divers trials on Diamonds with fire, he would not allow that fire itſelf can bring them to fuſion.

Nor are fluid Bodies, though but of ſmall Dimenſions, to be altogether excluded from the power of making conſiderable impreſſions on ſolid bodies,

bodies, if their celerity be great.

Whether the Sun-beams conſiſt, according to the Atomical Doctrine, of very minute Corpuſcles, that, continually iſſuing out of the body of the Sun, ſwiftly thruſt on one another in Phyſically-ſtraight Lines; or whether, as the *Carteſians* would have it, thoſe beams be made by the brisk action of the Luminary upon the contiguous fluid, and propagated every way in ſtraight lines through ſome Ethereal matter harboured in the pores of the Air; it will be agreeable to either *Hypotheſis*, that the Sun-beams, refracted or reflected by a burning-glaſs to a *focus*, do there, by their concourſe, compoſe a ſmall portion of fluid matter; and yet the *Celerity*, wherewith the ſoft and yielding ſubſtance is agitated, enables ſo few of them as can be circumſcribed by a Circle, not a quarter of an inch in Diameter, to ſet afire green wood in leſſe than a minute, and (perhaps in as little time as that) to melt not onely Tinn and Lead thinly

bea-

beaten, but, as I have tried, foliated Silver and Gold.

The operation of ſmall portions of fluid matter on ſolid bodies will be farther exemplified in the IV. *Chapter*, by the effects of the blown flame of a Lamp on glaſs and metalls; ſo that I ſhall here need but to point in general at the wonderfull effects that *Lightning* has produced, as well by the Celerity of its motion, as by the matter whereof it conſiſts. Of which Effects, Hiſtories and the writings of Meteorologiſts afford good ſtore; and I have been an admiring obſerver of ſome of them, one of the laſt of which was the melting of metal by the flame in its paſſage, which probably laſted but the twinckling of an Eye.

And even a ſmall parcel of Air, if put into a ſufficiently-brisk motion, may communicate a conſiderable motion to a ſolid body; whereof a notable Inſtance (which depends chiefly upon the Celerity of the ſpringy corpuſcles of the Air) is afforded by

by the violent motion communicated to a bullet ſhot out of a good wind-gun. For, when this Inſtrument is well charged, the ſtrongly-compreſt Air being ſet at liberty, and forcibly endeavouring to expand it ſelf to its wonted laxity, its corpuſcles give a multitude of impulſes to the bullet, all the while that it continues moving along the barrel, and by this means put it into ſo rapid a motion, that I found by trial, the bullet would in a moment be flatted, almoſt into the figure of a Hemiſphere, by being ſhot off againſt a metalline plate.

And farther to ſhew, How ſwift that motion muſt have been, and with what Celerity a vehement agitation may be communicated to the parts of a Solid body, I ſhall add here (though the *Phænomenon* might be referred to the V. *Chapter*,) that, though the contact of the Bullet and the metalline plate laſted probably but a phyſical moment; yet the minute parts of the bullet were put into ſo various and brisk an agitation, that making haſt

to

to take it up before it ſhould cool; I found it too hot to be with overmuch eaſe held between my fingers.

CHAP. III.

Obſervat. II. *We are too apt to think, that Fluid bodies, becauſe of their ſoftneſs, cannot have by their bare motion, eſpecially if inſenſible, any ſenſible effect upon Solid ones; though the fluid moves and acts as an intire body.*

'TIS not my purpoſe here to inſiſt on the efficacy of the motion of ſuch fluid bodies as may have their motions diſcovered by the eye, like ſtreaming water; or manifeſtly perceived by the touch, as are the winds that beat upon us: ſince 'twere needleſs to give Inſtances of ſuch obvious things, as the great effects of overflowing waters and violent winds; the later of which, notwithſtanding the great tenuity and ſoft-

ſoftneſs of the air and the *Effluvia* that ſwim in it, have been ſometimes able to blow down not onely timber-trees, but houſes and ſteeples, and other the firmeſt Structures. But the motions I intend to ſpeak of in this Chapter are ſuch, as we do not immediately either ſee or feel; and though theſe be exceeding rare, yet the operation of *Sounds*, even upon ſolid bodies, and that at a diſtance from the ſonorous ones, afford me ſome Inſtances to my preſent purpoſe, which I ſhall now proceed to mention.

It has been frequently obſerved, that, upon the diſcharge of Ordnance and other great Guns, not onely the ſound may be diſtinctly heard a great way off; but that, to a good diſtance, the tremulous motion of the Air that produces ſound, without producing any ſenſible wind, has been able ſenſibly to ſhake, and ſometimes violently to break, the glaſs-windows of houſes and other buildings, eſpecially when the windows ſtand in the way

wherein the propagation of the ſound is directly made. 'Tis true, that theſe obſervations are moſt frequent, when the place, where the Artillery is placed, ſtands upon the ſame piece of ground with the Houſes whoſe windows are ſhaken; and ſo it may be ſuſpected, that the Shake is firſt communicated by the Cannon to the earth or floor on which they play, and is afterwards by that propagated through the intermediate parts of the ground to the foundations of the houſes, and ſo to the windows. And I readily grant, and may elſewhere ſhew, that a violent impulſe upon the ground may reach to a greater diſtance than men uſually imagine: But in our preſent Caſe I ſee no neceſſity of having recourſe to any thing but the wave-like motion of the Air for the production of our Phænomenon, ſince the like may be produced by Local Motion tranſmitted by Fluids, as may appear by the following Inſtances.

I was once invited by an Engineer, to

to ſee triall made of a ſtrange Inſtrument he had to ſink ſhips, though great ones, in a few minutes; and though an unlucky Accident kept me from arriving there 'till near a quarter of an hour after the triall had been made on an old fregat, with better ſucceſſe than my Philanthropy allowed me to wiſh; yet cauſing my ſelf to be rowed to the place, where the great veſſell was newly ſunk, the odneſs of the effect, which was performed upon the water by a ſmall Inſtrument outwardly applied, made me inquiſitive, what noiſe and commotion had been made: And I was informed partly by the Engineer himſelf, and partly by ſome acquaintances of mine, who among a great number of Spectators ſtood aloof off in ſhips and other veſſels lying at anchor, to ſee the event; that, upon the Engine's operating, the exploſion was ſo great, that it made a kind of ſtorm in the water round about, and did ſo rudely ſhake veſſels that lay at no inconſiderable diſtance, as to make

thoſe that ſtood on them to ſtagger.

In the late great Sea-fight between the Engliſh Fleet commanded by his Royal Highneſs the Duke of *York*, and the Dutch Admiral *Opdam*, (who therein loſt the Victory and his Life,) though the Engagement were made very many Leagues from the *Hague*, yet the noiſe of the Guns not onely reached to that Place, but had a notable effect there; of which when I enquired of the Engliſh Embaſſadour that as yet reſided there, he was pleaſed to aſſure me, that it ſhook the windows of his Houſe ſo violently, that not knowing what the Cauſe was, he was ſurprized and much allarmed, apprehending, that ſome rude Fellows were about to break his windows to affront him. And if there be a greater diſpoſition in ſome other bodies than there is in Glaſs-windows to receive ſtrong impulſes from the Air agitated by Sounds, theſe may be ſenſibly, though not viſibly, wrought upon, and that at a good diſtance, by the noiſe of a ſingle piece

piece of Ordnance; as may appear by that memorable Circumſtance of an odd Caſe about a Gangrene mentioned by the experienced *Simon Pauli* in his ingenious Tract *de Febribus malignis*, pag. 71. *Atqui æger ille Gallus brachio truncatus, oĉiduum quidem ſuperfuit, ſed horrendis totius corporis convulſionibus correptus; qui quoque, (ut & illa addam obſervatione digniſſima,) dum in Domini ſui ædibus ad plateam Kiodmoggerianam, Romanè* Laniorum *appellares, decumberet, ac, me ac aliis aliquandiu ad Lectum illius conſidentibus quidem, ſed nobis non attendentibus, exploderentur tormenta bellica ex Regiis ac Prætoriis navibus, ſiniſtrâ truncum dextri brachii fovens ac complectens, toties quoties exploderentur ſingula exclamabat, Au, au, me miſerum! Jeſu, Maria, contundor penitùs: adeò permoleſta & intolerabilis illi erat Tormentorum exploſio, & quidem ex loco ſatis longinquo, terrâ non firmâ aut contiguâ, verùm ſuper ſalo aut mari Balthico, inſtituta.* By this it appears, that the Guns, whoſe diſcharge pro-

duced theſe painfull motions in the Patient, reſted upon a floating body. And I remember, that an illuſtrious Commander of a very great Man of war, being asked by me, whether of the many wounded men, he had in his ſhip in a very long Sea-fight, none of them were affected by that noiſe of the Enemy's Cannon diſcharged in ſhips at a diſtance? He anſwered me, that ſome, whoſe bones were broken, would ſadly complain of the Torment they were put into by the ſhake they felt at the going off of the Enemy's Cannon, though they were too much accuſtomed to the report of great Guns, to be, as 'twas a bare noiſe, offended by it. If after all this ſi be ſurmized, that theſe motions were not conveyed by the air, but propagated by the water, (and, in ſome caſes, ſome part of the ſhoar) from the ſhips, where the Guns were fired, to the Houſes where the windows were ſhaken, or the places where the wounded men lay: I anſwer, that, if this could be made probable,

bable, it would accommodate me with very eminent Inſtances for the Chapter of the *Propagable* nature of Motion: And though it be very difficult to find ſuch examples of ſhakes excited by ſounds as are not liable to the mentioned objection; becauſe the ſonorous bodies here below do all either ſtrike, or lean, upon ſuch groſs and viſible bodies as the Earth and Water; yet there is one kind of Sound, that muſt be confeſſed to be propagated by the Air, as being made in it; and that is *Thunder*, whoſe noiſe does ſometimes ſo vehemently affect the Air, though without producing any ſenſible wind, that both others and I have obſerved it very ſenſibly to ſhake great and ſtrong Houſes, notwithſtanding the diſtance of the clouds where the noiſes were firſt produced. And I remember, that, having inquired of ſome Sea-Captains, that in ſtout veſſels ſailed to the *Indies*, whether they had not in thoſe hot Regions obſerved their ſhips, though very much leſs tall then

houſes, to be ſhaken by vehement Thunders? I perceived, that ſome of them had not much heeded any ſuch thing; but a couple of others told me, they had obſerved it in their ſhips; and one of them told me, that once, when the claps of thunder were extraordinary great, ſome of them ſhook his ſhip ſo rudely as to make the unwonted motions diſorder his great Guns. All which I the leſs wonder at, when calling to mind, what I have mention'din the foregoing Chapter and elſewhere of the power of the Celerity of motion, I conſider, that there is no Celerity that we know of here below, that is near ſo great, as that wherewith a Sound is propagated through the air. For, whereas the diligent *Merſennus* obſerves, that a bullet ſhot out of a Cannon or a Musket does not overpaſs two hundred and forty yards in a Second, or ſixtieth part of a minute; I have more than once diligently obſerved, that the motion of *Sound* paſſes above four hundred yards in the

ſame

ſame time of a Second here in *England*; which I therefore add, becauſe *Merſennus* relates, that in *France* he obſerved a Sound to move in that time many yards more; which may poſſibly proceed from the differing conſiſtence of the Engliſh air and the French.

The great Loudneſs of theſe ſounds, and the vehement percuſſion that the Air receives in their formation, will probably make it be eaſily granted, that 'twas onely the Impetuoſity of the motion of the *Medium*, that gave the ſhake to the windows and other ſolid bodies that I have been mentioning to have been made to tremble by the report of Cannon or Thunder: But yet I will not on this occaſion conceal, that perhaps it may without abſurdity be ſuſpected, that Some of thoſe tremulous motions of ſolid bodies might either depend upon, or at leaſt be promoted by, ſome peculiar diſpoſition, that Glaſſe (which is endued with ſpringineſs,) and ſome other bodies that perhaps are not quite devoid of that Quality,

may

may have to be moved by certain congruous Sounds (if I may ſo call them) more than they would by others, though perchance more loud. But though this ſurmize ſhould be admitted; yet it would not render the lately-recited Inſtances improper for the deſign of this Diſcourſe, but onely would make ſome of them fit to be referred to another *Chapter*; to which I ſhall advance, as ſoon as I ſhall have annexed an odd Obſervation of the experienced *Platerus*, which argues, that, where there is a peculiar Diſpoſition, even in a firm body, it may receive conſiderable impreſſions from ſo languid a motion (though in likelihood not peculiarly modified) of the air as is not ſenſible to other bodies of the ſame kind.

Plater. Obſerv. Lib. 1. p. 185. *Fœmina quædam* (ſays he) *in ſubitaneum incidit morbum, viribus ſubitò proſtratis, ſe ſuffocari indeſinenter clamitans, etſi nec ſtertoris nec tuſſis aliqua eſſent indicia; maximè verò de aura quadam adveniente, ſi vel leviter aliquis adſtantium ſe moveret,*

moveret, quæ illam opprimeret, conquerebatur, ſéque ſuffocari, ſi quis propiùs accederet, clamitabat: vixdum biduum in ea anxietate perſeverans, expiravit. To which he adds: *Vidi & alios ægros, de ſimili aura, quæ eos, ſi quis illis appropinquaret, in ſuffocationis periculum induceret, conquerentes; quod ſemper peſſimum eſſe ſignum deprehendi.*

CHAP. IV.

Obſervat. III. *Men undervalue the motions of bodies too ſmall to be viſible or ſenſible, notwithſtanding their* Numerouſneſs, *which inables them to act in Swarms.*

MOſt men, when they think at all of the *effluvia* of bodies and their motions, are wont to think of them as if they were but much finer ſorts of Duſt, (whoſe grains, by reaſon of their ſmalneſs, are inviſible,) which, by the various agitation of the Air, are as

as 'twere by ſome faint wind blown againſt the ſurfaces of the bodies they chance to meet in their way, and that they are ſtopped in their progreſs without penetrating into the interior parts of the bodies they invade. And according to this Notion, 'tis no wonder, that men ſhould not fancy, that ſuch minute bodies paſſing, as they ſuppoſe, no further than the ſurfaces of thoſe on which they operate, ſhould have but faint operations upon them.

But we may have other thoughts, if we well conſider, that the Corpuſcles we ſpeak of, are, by their minuteneſs, aſſiſted, and oftentimes by their figure inabled, to pierce into the innermoſt receſſes of the body they invade, and diſtribute themſelves to all, or at leaſt to multitudes of the minute parts, whereof that body conſiſts. For this being granted, though we ſuppoſe each ſingle *effluvium* or particle to be very minute; yet, ſince we may ſuppoſe, even ſolid bodies to be made up of particles that are ſo too, and the number of invading particles

to

to be not much inferior to that of the invaded ones, or at leaſt to be exceedingly great, it need not ſeem incredible, that a multitude of little Corpuſcles in motion (whoſe motion, may, for ought we know, be very ſwift) ſhould be able to have a conſiderable operation upon particles either quieſcent, or that have a motion too ſlow to be perceptible by ſenſe. Which may perhaps be the better conceived by the help of this groſs example:

If you turn an Ant-hill well ſtocked with Ants-eggs, upſide down, you may ſometimes ſee ſuch a heap of eggs mingled with the looſe earth, as a few of thoſe Inſects, if they were yoaked together, would not be able at once to draw after them; but if good numbers of them diſperſe themſelves and range up and down, and each lay hold of her own egge, and hurry it away, 'tis ſomewhat ſurprizing to ſee (as I have with pleaſure done) how quickly the heap of eggs will be diſplaced, when almoſt every little egge has

one

one of thoſe little Inſects .to deal with it.

And in thoſe caſes, wherein the invading Fluid does not quite disjoin and carry off any great number of the parts of the body it invades, its operation may be illuſtrated by that of the wind upon a tree in *Autumn*: for, it finds or makes it ſelf multitudes of paſſages, for the moſt part crooked, not onely between the branches and twigs, but the leaves and fruits, and in its paſſing from the one ſide to the other of the tree, it does not onely variouſly bend the more flexible boughs and twigs, and perhaps make them grate upon one another, but it breaks off ſome of the ſtalks of the fruit, and makes them fall to the ground, and withall carries off divers of the leaves, that grew the leaſt firmly on, and in its paſſage does by its differing parts act upon a multitude of leaves all at once, and variouſly alters their ſituation.

But to come to cloſer Inſtances: ſup-

ſuppoſe we caſt two lumps, the one of Sugar, the other of Amber, into a glaſs of beer or water, they will both fall preſently to the bottom. And though perhaps the Amber may be lighter than the Sugar, (for, I have found a notable difference in the ſpecific gravity of pieces of Amber,) yet the aqueous particles are far from being able to diſplace the Amber or any ſenſible part of it, or exerciſe any viſible operation upon it: But the ſame minute particles of the liquor being of a figure that fits them to inſinuate themſelves every way into the pores of the Sugar, though the lump conſiſted of very numerous Saccharine Corpuſcles, yet the multitude of the aqueous particles, to which they are acceſſible, is able in no long time to diſperſe them all, and carrying them along with themſelves, make the whole lump of Sugar in a ſhort time quite diſappear.

The point above diſcourſed of, may be more nimbly exemplified in ſome Chymical operations, and particu-

ticularly in this. If, by a due degree of fire, you abſtract from running Mercury four or five times its weight of good Oil of Vitriol, there will remain at the bottom a dry and brittle ſubſtance exceeding white; and, if upon this Heap of Mercurial and Saline bodies, which ſometimes may be coherent enough, you pour a good quantity of limpid water, and ſhake them together, you may ſee in a trice the multitude of little white grains, that make up the maſſe, pervaded, and manifeſtly altered, by the diſperſed Corpuſcles of the water; as will plainly appear by the change of the *Calx* or *Precipitate* from a white maſſe into one of a fine Limon-colour.

But to give inſtances in Fluid bodies, (which I ſuppoſe you will think far the more difficult part of my task,) though you will eaſily grant, that the flame of Spirit of wine, that will burn all away, is but a viſible aggregate of ſuch Effluvia ſwiftly agitated, as without any ſenſible Heat would

would of themſelves inviſibly exhale away; yet, if you be pleaſed to hold the blade of a knife, or a thin plate of Copper, but for a very few minutes, in the flame of pure Spirit of wine, you will quickly be able to diſcern by the great Heat, that is, the various and vehement agitation of the minute Corpuſcles of the metal, what a number of them muſt have been fiercely agitated by the pervaſion of the igneous particles, if we ſuppoſe, (what is highly probable,) that they did materially penetrate into the innermoſt parts of the metall; and whether we ſuppoſe this or no, it will, by our experiment, appear, that ſo fluid and yielding a body, as the flame of Spirit of wine, is able, almoſt in a trice, to act very powerfully upon the hardeſt metalls.

The power of extreamly-minute parts of a fluid body, even when but in a moderate number they are determined to conſpire to the ſame operation, may be eſtimated by the

motions of Animals, especially of the larger and more bulky sorts, as Horses, Bulls, Rhinocerots and Elephants. For, though the animal spirits be minute enough to be invisible, and to flow through such tender passages, that prying Anatomists have not been able in dissected Nerves to discern so much as the channels through which they pass; yet those Invisible Spirits, conveyed (or impelled) from the Brain to the Nerves, serve to move in various manners the Lims, and even the unwieldy bodies themselves of the greatest Animals, and to carry them on in a progressive motion for many hours together, and perhaps enable them to spring into the Air, and move through it by leaping; though divers of these Animals weigh many hundred, and others several thousand of pounds.

I will not here consider, whether the following Experiment may at all illustrate Motions that are produced by the fluid parts of Animals in some of

of the consistent ones: But I presume, it may confirm the Observation maintained in this Chapter, if I add, what I have tried of the considerable force of a number of aqueous particles, as flexible and as languid as they are thought to be, insinuating themselves into the pores or Intervals of a rope that was not thick. For in moist weather I sometimes observed, that the aqueous and other humid particles, swimming in the air, entering the pores of the hemp in great numbers, were able to make it shrink, though a weight of fifty, sixty, or even more pounds of lead were tied at the end to hinder its contraction, as appeared by the weights visibly being raised in wet weather above the place it rested at in dry.

But to return to what I was formerly speaking of the Determination of the motion of Fluids; I shall, on this occasion, observe, that, though the wind or breath, that is blown out at a small crooked pipe of metal or glass, such as Tradesmen for its

uſe call a Blow-pipe, ſeems not to have any great celerity, eſpecially in compariſon of that of the parts of flame; and is it ſelf of little force; yet, when by this wind the flame of a Lamp or Candle is directed ſo as to beat with its point upon a body held at a convenient diſtance from the ſide of the flame, the burning fluid, determined, and perhaps excited by this wind, acquires ſo great a force, that, as we have often tried, it may be made, in a few minutes, to melt not onely the more fuſible Metals, but ſilver, or even copper it ſelf; which yet may be kept for many hours unmelted in a Crucible kept red-hot, or even in the flame of the Lamp or Candle, unaſſiſted by the blaſt.

And if we can ſo contrive it, that a flame does not come to invade onely the ſurface that inveſts a body, but comes to be intermingled with the ſmaller (though not the ſmalleſt) parts it conſiſts of, as with its filings or its powder; the flame will then have a far more quick and powerfull ope-

operation than the body expoſed to it. This I exemplify (in other Papers) and in this place it may ſuffice to obſerve, that, whereas a pound or two of Tartar may coſt you ſome hours to calcine it to whiteneſs, if the flame have immediate acceſs onely to the outward parts; you may calcine it in a very ſmall part of that time, if, mixing with its groſs powder an equal weight of good Salt-peter, you fire the mixture, and keep it ſtirring, that the parts of the kindled Nitre may have acceſs at once to very many parts of the Tartar, and have opportunity to calcine them. And by ſomewhat a like artifice, I elſewhere teach, how Nitre it ſelf may without Tartar be ſpeedily reduced to a *Calcinatum*, not unlike that newly mentioned. But it may be ſaid, that ſome of the foregoing Inſtances (for it cannot be truly ſaid of all) may indeed illuſtrate what we are diſcourſing of, but will not reach home to our purpoſe.

I ſhall therefore conſider the

Load-ſtone, which you acknowledge to act by the emiſſion of Inſenſible particles. For, though Iron and Steel be ſolid and ponderous bodies, and Magnetical *effluvia* be corpuſcles ſo very minute, that they readily get in at the pores of all kind of bodies, and even of Glaſs it ſelf; yet theſe Magnetical *effluvia*, entring the ſteel in ſwarms, do in a trice pervade it, and a multitude even of Them, acting upon the Corpuſcles of the metal, do operate ſo violently on them, that, if the *Load-ſtone* be vigorous enough, and well capped, it will attract a notable proportion of ſteel, and ſurmount the gravity of that ſolid metal, which I have found to exceed, when the ſtone has been very good and little, above fifty times the weight of the Magnet by whoſe *effluvia* it was ſupported: For, to theſe I rather aſcribe Magnetical attraction and ſuſtentation, than to the impulſe or preſſure of the ambient air, to which many Corpuſcularians have recourſe; becauſe I have found by trial (which

I elſe-

I elſewhere relate) that the preſſure of the ambient air is not abſolutely neceſſary to Magnetical operations.

I remember, that, to help ſome friends to conceive, how ſuch extreamly-minute particles as Magnetical *effluvia*, may, by pervading a hard and ſolid body, ſuch as Iron, put its inſenſible Corpuſcles into motion, and thereby range them in a new manner, I took filings of Steel or Iron freſhly made, that the Magnetical virtue might not be diminiſhed by any ruſt, and having laid them in a little heap upon a piece of paper held level, I applied to the lower ſide of the paper, juſt beneath the Heap, the pole of a vigorous Load-ſtone, whoſe Emiſſions traverſing the paper, and diffuſing themſelves through the incumbent metall, did in a trice manifeſtly alter the appearance of the Heap; and, though each of the filings might probably contain a multitude of ſuch ſmall Martiall Corpuſcles as Steel may be divided into by Oil of Vitriol or Spirit of Salt; yet the Mag-

netical *effluvia*, immediately pervading our metalline heap, did ſo remove a good part of the filings that compoſed it, as to produce many erected aggregates, each of which conſiſted of ſeveral filings placed one above another, and appearing like little needles, or rather like the ends of needles broken off at ſome diſtance from the point. And as theſe little temporary needles ſtood all of them erected (though more or leſs, according to their diſtance from the Pole of the Magnet) upon the flat paper; ſo they would, without loſing their figure or connexion, be made as it were to run to and fro upon the paper, according as the Load-ſtone, that was held underneath it, was moved this way and that way; and as ſoon as that was taken quite away, all this little ſtand of pikes (if I may ſo call it) would (almoſt in the twinkling of an eye) relapſe into a confuſed heap of filings.

There are two ways of explicating the turning of Water into Ice; one

or other of which is approved almoſt by all the Corpuſcularian Philoſophers. The firſt is that of the *Carteſians*, who give an account of Glaciation by the receſſe of the leſs ſubtile particles of the Etherial matter, without which the finer parts were too ſmall and feeble to keep the Eel-like particles of water flexible, and in the form of a liquour. The *Atomiſts* on the other ſide aſcribe the freezing of water to the ingreſs of multitudes of *frigorifick* Corpuſcles, as they call them, which, entering the water in ſwarms, and diſperſing themſelves through it, crowd into the pores, and hinder the wonted motion of its parts, wedging themſelves (if I may ſo ſpeak) together with them into a compact body. But which ſoever of theſe two *Hypotheſes* be pitched upon, the Phænomenon it ſelf will afford me a notable Inſtance to my preſent purpoſe. For, the Particles of water, and much more the Corpuſcles of cold, are confeſſed to be ſingly too ſmall to be viſible,

visible, and their motions are not said to be swift, but may rather be judged to be slow enough; and yet those minute aqueous, or more minute frigorifick particles, because of their number, produce in the glaciation of the liquour so forcible a motion outwards, as to make it break bottles, not onely of glass and earth strongly baked, but, as I have several times tried, of metal it self, that being full of the liquour were firmly stopped before the supervening of the Cold. And the expansive endeavour of freezing water is not onely capable of doing this, but of performing so much greater things, which I elsewhere relate, that my trials have made me sometimes doubt, whether we know any thing in nature, except kindled Gunpowder, that bulk for bulk moves more forcibly, though the motion seems to be very slow.

CHAP.

CHAP. V.

(Of the Propagable Nature of Motion.)

Obſervat. IV. *Men are not ſufficiently aware, how propagable Local Motion is, even through differing Mediums, and Solid bodies.*

THere are four principal Occaſions on which I have obſerved, that men are wont to think the Communicating of Motion much more difficult than indeed it is.

And *firſt*, there are many, that obſerving how uſually thoſe bodies that hit againſt hard ones rebound from them, eaſily perſwade themſelves, that Motion can ſcarce be tranſmitted or diffuſed through Solid bodies. But though it be true, that oftentimes in ſuch caſes the progreſſive motion of the body or the Solid,

Solid, that is ſtruck or impelled, be either inconſiderable, or, perhaps, not ſo much as ſenſible; yet the impulſe may make a conſiderable impreſſion, and may be communicated to a great ſhare of the particles of that matter, whereof the ſolid maſs conſiſts; as we ſee in the ſtriking of a timber-beam at one end, the motion, though perhaps it were not ſtrong at the firſt, may become ſenſible at the other. Though Bell-metal be ſo hard a body, that it is reckoned harder than iron it-ſelf, inſomuch that oftentimes it reſiſts even files of Steel, which readily work on Iron; yet this ſolidity hinders not but that, as I have found, conveniently ſhaped veſſels of Bell-metal, though thick, will be ſenſibly affected by a motion that neither is ſtrong, nor touches them in more than a ſhort line, or perhaps than a Phyſical point. The truth of this I have found by trial on more than one ſuch veſſels and particularly on one that was hemiſphærical, which being placed or held in a convenient poſture,

poſture, if I did but gently paſs the point of a pin for a little way along the brim of it, it would ſenſibly reſound, and that (to a very attentive ear) ſo long, and in ſuch a ringing manner, as made it highly probable, that the parts, immediately touched (and not ſo much as ſcratched) by the point of a pin, were not onely put into a vibrating motion themſelves, but were enabled to communicate it to thoſe that were next them, and they to thoſe that were contiguous to them; and ſo the tremulous motion was propagated quite round the bell, and made divers ſucceſſive Circulations before it quite ceaſed to be audible. And if, in ſtead of drawing a Line on the brim of the veſſel, I ſtruck it, though but faintly, with the point of a pin, though the part immediately touched would be but a phyſical point, yet the motion would be, like the former, propagated ſeveral times quite round; as was argued by the ringing and duration of the produced ſound, though this metal-

metalline veſſel were ſeven inches in Diameter, and of a conſiderable thickneſs. Nor was a ſolidity like that of Braſs requiſite to produce theſe effects. For I found them to inſue much after the ſame manner, when I employed onely a ſhort and ſlender thread of Glaſs, which though little, if at all, thicker than a pin, was yet hollow quite through. Now if it be true, as 'tis highly probable, that Sound, as it belongs to the air, conſiſts in an undulating motion of the Air, and ſo in our caſe requires a vibrating motion in the ſonorous body to impart that motion to the Air; we muſt grant in our Inſtances a wonderfull propagableneſs of motion, even when 'tis not violent, in Solid bodies themſelves; ſince the point of a pin, gently ſtriking a part, no bigger than it ſelf, of a maſs of very ſolid metal, could thereby communicate a ſenſible motion, and that ſeveral times circulated, to millions of parts equall to it in bulk, and much exceeding it in hardneſs. And ſince the

the effect was more conſiderable, when the trial was made in a much greater, than in a ſmaller veſſel; 'tis probable, that, if I had had the opportunity of experimenting on a large and well-hung Bell, the *Phænomenon* would have been more notable; as it alſo ſeemed to be on our veſſel, if, in ſtead of ſtriking it with the point of a pin, we caſt, though but faintly, againſt the lower part of it a grain of ſhot, leſs than a ſmall pins-head, or let a little grain fall, from about one foot high, upon the inſide of the inverted Hemiſphere. And to ſhew, that even ſoft and yielding bodies, and but faintly moved, are not to be excluded from a power of putting ſuch hard ones into motion; I ſhall add, that I found almoſt the like effects to thoſe above mentioned, by paſſing the pulp of my finger a little way along the lower part of the veſſel. Nay, that fluid bodies themſelves may communicate ſuch an inteſtine and propagable motion, to harden ſolid ones, I may have hereafter

after an occaſion to ſhew by the effects of a ſmall Flame, and the Sun-beams on glaſs and ſteel. And I ſhall here on this occaſion add this word about the Propagation of Motion produced in ſolid bodies by heat, that it much depends upon the particular Textures of the bodies. For I found, that when I heated a piece of glaſs or of a fire-ſtone, I could without inconvenience hold my naked hand upon parts that were very near (ſuppoſe within an inch off) the ignited portions of them. But, if we take a rod of Iron, for inſtance, and heat one end red-hot, the heat of that end will be ſo propagated towards the other, that it will offend one's hand at ſeveral times the diſtance, at which one might conveniently hold the rod, if it were of glaſs.

In many buildings it may be obſerved, (and is thought a ſign of the firm Coheſion of their parts,) that a ſtamp of one's foot, nay or bare treading, or ſome ſuch other leſſe briſk impulſe, made in one room, will

will have a ſenſible effect in all or moſt of the others. And it often happens, that, by the haſty ſhutting of a door, the whole houſe is made to tremble; whence we may argue, that, even among ſolid bodies, motion made in one place may be readily propagated to many others: And if, as to the latter of the Inſtances, the ſudden impulſe and compreſſion of the Air, made by the door ſuppoſed to be haſtily ſhut, have any conſiderable ſhare in the effect, the Phænomenon will ſerve to ſhew the efficacy even of ſuch a motion of a fluid body, as we cannot directly feel upon divers large and firmly connected ſolid bodies.

In *Earthquakes* the tremulous motion ſometimes extends ſo very far, that, though it ſeems highly probable, that the ſhake that is given to one part of the Earth by the firing and exploſion of ſubterraneal exhalations, (if that be the true and onely cauſe of Earthquakes) is not capable of reaching near ſo far as divers

Earthquakes have done, but that the fire passes through some little subterraneal clefts, or channels, or hidden conveyances, from one great Cavity or Mine to another; yet 'tis not improbable but that the vehemently tremulous motion does oftentimes reach a very great way beyond the places where the explosions were made. Since, though *Seneca* would confine the extent of Earthquakes to two hundred miles, yet observations made in this and the last Century warrant us to allow them a far greater spread. The Learned *Josephus Acosta* affirms, that in the Kingdom of *Peru* in the year 1586 an Earthquake reached along the shoar of the Pacifick sea 160 Leagues; and adds, that sometimes it has in those parts run on from South to North 300 Leagues. And in the beginning of this our age (*Anno Dom.* 1601) good writers relate a much larger Earthquake to have happened, since it reached from

Natur. Quæst. Lib. VI. Cap. 25.

Lib. III. Cap. 26.

Asia

Asia to that Sea that washes the *French* Shoars, and, besides some *Asiatick* Regions, shook *Hungary*, *Germany*, *Italy* and *France*, and consequently a great part of *Europe*. And if that part of the Narrative be certain, which relates, that this lasted not much above a quarter of an hour, it will be the more likely, that this Earthquake shook great Tracts of Land beyond those places, to which the fired matter, passing from one cavity to another, could reach in so short a time: As you will the more easily guesse, if you try, as I have done, that in trains of Gunpowder it self the fire does not run on near so swiftly as one would imagine. But though I have been in more Earthquakes then one; yet, since they were too sudden and too short to afford me any considerable observation, I shall say no more of them; but proceed to take notice, that oftentimes the motion of a Coach or Cart, that passed at a good distance from the place that I was in, has made the

buildings ſo ſenſibly ſhake, that I could not but wonder, that ſo great a portion of ſo firm and ſluggiſh a body, as the Earth, could, by a cauſe that ſeemed very diſproportionate to ſuch an effect, be made to tremble it ſelf, and manifeſtly to ſhake firm buildings that were founded on it. And this obſervation made me the more inclinable to give credit to their Relations, who tell us, that in a calm night, the march of a troup of horſe may be felt, by attentive Scouts watching at a great diſtance off, by the ſhake that the ground receives from the trampling of the horſes; though I formerly ſuſpected much, and do yet a little, that the impulſe of the air conveyed along the reſiſting ſurface of the ground, might mainly contribute to the effect that is aſcribed onely to the motion of the ſoil.

Before I advance to the *Second* Member of this Chapter, it may not be impertinent to note, that in peculiarly diſpoſed bodies, and eſpecially in Organical ones, a very *languid* moti-

motion may have a far greater effect, than it could produce by a bare propagation of it ſelf. For it may ſo determine the motion of the Spirits or other active parts of the body it works on, as to make multitudes of them act as if they conſpired to perform the ſame motions. As when a tickliſh man, by having the pulp of one's finger paſſed gently along the ſole of his foot or the palm of his hand, has divers muſcles and other parts of his body and face put into preternatural or unuſual motions. And moſt men by being lightly tickled with the end of a feather or ſtraw, within their Noſtrils, have their heads and many parts of their bodies put into that violent Commotion, wherein *Sneezing* conſiſts. And I remember, that having for ſome time been, by a diſtemper, (from which God was graciouſly pleaſed a while after to free me,) quite deprived of the uſe of my hands; it more than once hapned to me, that ſitting alone in a Coach, if the wind chanced to

blow a ſingle hair upon my face in the Summer-time, the tickling or itching, that it produced, was ſo uneaſy to me, 'till by calling out to a footman I could get it removed, that, though I could well bear it as long as I was wont to do, when, having the uſe of my hands, I could relieve my ſelf at pleaſure; yet if I were forced to endure the itching too long, before any came to ſuccour me, the uneaſineſs was ſo great, as to make me apprehend falling preſently either into Convulſions or a Swoon. But 'tis time to proceed to the *ſecond* Member of this Chapter.

2. Others there are, that cannot believe, that Local motion, eſpecially if it be *languid*, can be propagated through differing Mediums, each of which, ſave that wherein the Motion is begun, muſt, they think, either repell, or check and dead it. To theſe I ſhall recommend the Conſideration of an Experiment, I remember I made before ſome Learned men in our Pneumatick Engine. For, having cau-

caused a large and thick glass Receiver to be so blown, that it had a glass button in the inside of that part which upon the Engine was to be placed upwards; I caused a Watch to be suspended by a little Silver-chain fastned to that button by as slender and soft a body, as I thought would be strong enough to support my watch; and then, the Glass being cemented on close to the Receiver, to prevent a Commerce between the Cavity of it and the Air, the watch, that hung freely near the middle of the Cavity of the Receiver, made it self to be heard by those attentive Listners, that would hold their ears directly over the suspended watch, whose motions were thereby argued to have been propagated, either through the included air, or along the string to the concave part of the Glass, and through the whole thickness of the Glass to the convex part, and thence, through the interposed air to the Ear. And this mention of watches minds me of what I often ob-

ſerved in a ſmall ſtriking watch, that I have worn in my pocket. For, when it ſtruck the Hours, and in ſome poſtures when the balance did but move, I could plainly feel the briſker motions of the Bell, and ſenſibly the languid ones of the balance, through the ſeveral linings of my Breeches, and ſome other interpoſed ſoft and yielding bodies; and this, though the watch (as I ſaid) was ſmall, and the balance included in a double caſe, and though the outwardmoſt were of (what they call) Chagrine, and the innermoſt of Gold; which I therefore mention, becauſe that cloſeſt of metals is obſerved more to dead ſounds and motions than harder metals, as Silver, Copper, and Iron.

That Motion may be propagated through differing Mediums, may ſeem the more probable by the ſhakings that are often felt by men lying on beds that ſtand in rooms cloſe ſhut, when loud claps of thunder are produced (perhaps at a great diſtance off) in the clouds. And whether it will

will be fit to add to this Inſtance that which you have lately met with in the III. Chapter of a wounded Frenchman at *Copenhagen*, I leave you to conſider.

I know not whether it will be very proper to take notice on this occaſion of an odd *Phænomenon* recited by the experienced *Agricola* in theſe words. *Si animal dejicitur in antrum Viburgenſe, quod eſt in Carelia, Regione Scandiæ, erumpit, ut perhibent, ſonus intolerabilis magno cum flatu: Si leve pondus in ſpecum Dalmatiæ, quamvis, inquit Plinius, tranquillo die, turbini ſimilis emicat procella.* *De nat. eorum quæ effl. è Terra Lib. IV. Cap. 7.*

3. As thoſe of whom I took notice at the beginning of this Chapter, are backward to allow, that Motion may be conſiderably propagated through *ſolid* bodies; ſo on the contrary, there are others that are indiſpoſed to think, that 'tis near ſo propagable as indeed it is through *fluid* bodies; becauſe they preſume, that the eaſy ceſſion of the parts of fluids will

will dead the impulſe received by thoſe of them that are firſt acted on by the impelling body. And

4. There is yet another ſort of Naturaliſts, who, though they may be brought to grant, that Motion may by propagated even through a ſoft and yielding Medium, cannot believe, that it ſhould through ſuch a Medium be propagated to any conſiderable diſtance; being perhaps induced to this opinion by obſerving, that, though a body ſomewhat broad as well as ſolid, as the Palm of one's hand or a battledore, be moved through the Air ſwiftly enough to make a wind; yet that wind will not be ſtrong enough to be felt any more than a very little way off. Wherefore, becauſe the Inſtances, to which I aſſign the remaining part of this Chapter, may be for the moſt part applicable to the removal of both theſe prejudices; It may for brevity ſake be expedient to conſider them both together.

If Luminous bodies act on our Eyes,

Eyes, not by a ſubſtantial diffuſion of extreamly minute particles, as the *Atomiſts* would have it, but by a propagated Pulſion of ſome Subtile matter contiguous to the ſhining body, (as the *Carteſians* and many other Philoſophers maintain;) 'twill be manifeſt, that a body leſs than a ſmall pin's head may give a brisk motion to a portion of fluid matter many millions of times greater than it ſelf; ſince in a dark night a ſingle ſpark of fire may be ſeen in differing places, whoſe diſtance from it exceeds many thouſand times the ſpark's *Diameter*. Not to mention the great remove, at which the flame of a ſmall taper may not onely be ſeen, but appear greater than near at hand. And if we compare the *Diameter* of that bright Planet *Venus*, which yet ſhines but with a borrowed and reflected Light, with its *diſtance* from the Earth, we may eaſily conclude, that the fixed Stars, which probably are ſo many Suns that ſhine by their own native Light, muſt impell a ſtupendi-

pendious proportion of Etherial matter, to be able at that immenſe diſtance to make ſuch vivid Impreſſions, as they do, upon our Eyes. But to deſcend to Inſtances leſs remote and diſputable, I ſhall, in order to the removal of the two lately mentioned prejudices, proceed to conſider; that, though it be true, that Fluid bodies do eaſily yield to Solid ones that impell them, and thereby oftentimes quickly dead the motion of thoſe Solids; yet the motion, being loſt onely in regard of the ſolid body, is not loſt, but tranſmitted and diffuſed in reference to the fluid. As when a log of wood, or any ſuch body ſpecifically lighter than water, is let fall in the middle of a pond, though its progreſs downwards be checkt, and it be brought to reſt quietly on the ſurface of the water; yet its motion is not loſt, but communicated to the parts of the water it firſt ſtrikes againſt, and by thoſe to others, 'till at length the curls or waves produced on the ſurface of the wa-

ter

ter ſpread themſelves, till they arrive at the brinks, and would perhaps be farther expanded, if theſe did not hinder their progreſs. From which inſtance we may learn, that, though the nature of fluid bodies, as ſuch, requires, that their parts be actually diſtinct and ſeparately moved; yet the particular Corpuſcles that compoſe them, being (at leaſt here below) touched by divers others, the new motion that is produced in ſome of them by an impellent Solid, muſt needs make them impell the contiguous Corpuſcles, and theſe thoſe that chance to lie next to them, and ſo the impulſe may be propagated to a diſtance; which you will the more eaſily believe may be great, if you conſider with me, both that in a fluid body the Corpuſcles, being already in the various motion requiſite to fluidity, yield more eaſily to the impellent, and alſo that being fully, or very near it, counterpoiſed by others of the ſame fluid, a ſcarce imaginably little force may ſuffice to impell them;

them; insomuch that, though the brass Scale of a balance, of divers inches in Diameter, may well be supposed to outweigh many myriads of such particles as compose water, wine, &c. yet, (as I elsewhere more fully relate) when such a scale was duly counterpoised with another like it, I could easily put it into various motions onely with the invisible *Effluvia* of no great piece of Amber. And if we consider that obvious Instance of the swelling Circles made by casting a stone into a Pond or other stagnant water, we shall be the more easily perswaded, that, even in a heavy fluid, a motion may reach a far greater way, than men are usually aware of, beyond the parts on which it was first impress.

On this occasion I must not omit a strange Observation given me by a very experienced Navigator, that much frequents the Coast of *Groenland*, and other *Arctick* Regions, to fish for whales. For this person being discoursed with by me about the effects

fects of the breaking of those vast piles of Ice, that are to be met with in those parts, assured me, that not onely he had often heard the Ice make in breaking terribler noise than the loudest claps of thunder with us, but that sometimes, when the Sea-water had, as it were, undermined the foundation of the mountainous piece of Ice, he has known it at length suddenly fall into the subjacent Sea with so much violence as to make a storm at a great distance off; insomuch that once, when he lay two Leagues off of the place where this stupendious mass of Ice fell, it made the waves goe so high as to wash clear over the stern of the ship, with danger enough to some of his men, and to sink several of his shallops that were riding by, though scarce any small vessels in the world use to be so fitted for rough Seas as those about *Groenland*.

And whereas, though the Air be a much thinner fluid, we are apt to think it indispos'd to propagate motion

tion far, give me leave to tell you, that we may take wrong meaſures, if we think, that, (for inſtance) the undulating motion, into which the Air is put by the action of ſonorous bodies, reaches but a little way, as we are apt to preſume it does, becauſe we judge of it by the effect it has on our ears when the ſound is made in diſadvantageous places. For one, that, for inſtance, hears a Lute or a Viol plaid on in a room furniſhed with hangings, will be apt to think the ſound faint and languid in compariſon of what it would appear to him, if the ſame Inſtrument were plaid on after the ſame manner in an arched room without hangings; theſe ſoft and yielding bodies being apt to dead the ſound, which the figure and hardneſs of the Vaulted room would reflect. And ſo, when a man ſpeaks aloud in the free Air, we are not wont to take any notice of a progreſs made by the motion of the Air beyond the place we are in, when our ears receive the ſound; but if the place happen

to

to be furniſhed with an *Echo*, though at many times that diſtance from the ſpeaker, we may then eaſily take notice, that the motion of the Air was carried on, and that with good vigour, to a far greater diſtance than elſe we ſhould have obſerved. And I have often thought, that, even by the better ſort of our Echoing places, we are not informed, to near how great a ſphere the motion, which the Air is put into by Sounds, may extend it ſelf, where its diffuſion and vigour are not hindred nor weakned by bodies either placed too near, or indiſpoſed to promote its operation.

What has been lately ſaid of the great diffuſion of Sounds, if themſelves be loud and great, will appear highly probable, by what is related by the Learned *Fromundus*, who being Profeſſour of Philoſophy at *Lovain*, in the Year 1627, had opportunity enough to know the Truth of what he relates; namely that, at the famous Siege of *Oſtend* in *Flanders*, the *From. Meteor. Lib. II. Art. 9.*

thunder of the great Ordnance was heard at above thirty Dutch Leagues, which, according to the vulgar reckoning, amounts to a hundred and twenty of our Engliſh miles. And that is yet, as he truly obſerves, more ſtrange, and makes more for our preſent purpoſe, which he adds concerning the diffuſion of the ſound of a Drum, which, he ſays, was, upon a time, heard at Sea twelve Leagues off.

But to return to what I was ſaying of *Echo's*, to confirm my conjecture about them, I ſhall think it needleſſe to offer you any other Argument, than that which you will draw your ſelf from the Notable Relation I met with in the Learned *Varenius* of an Obſervation made by *David Frælichius*, who, in the Company of a couple of Students, had the curioſity (in the month of *June*) to viſit the mountain *Carpathus*, eſteemed the higheſt of all the *Hungarian* Hills, and ſaid to be much more ſteep and difficultly acceſ-

Geograph. general. Lib. I. Cap. XIX.

ceſſible than any of the *Alps* themſelves. *Frælichius* then (in my Authour) having related with what difficulty he and his Companions aſcended above that Region of the Air, where they met with clouds and vehement winds, adds this memorable Obſervation, for whoſe ſake I mention the ſtory: *Exploſi* (ſaies he) *in ea ſummitate ſclopetum, quod non majorem ſonitum primò præ ſe tulit, quàm ſi tigillum vel bacillum confregiſſem; poſt intervallum autem temporis murmur prolixum invaluit, inferioréſque montis partes, convalles, & ſylvas oplevit. Deſcendendo per nives annoſas intra convalles, cùm iterum ſclopetum exonerarem, major & horribilior fragor quàm ex tormento capaciſſimo inde exoriebatur: hinc verebar, nè totus mons concuſſus mecum corrueret; duravitque hic ſonus per ſemiquadrantem horæ, uſque dum abſtruſiſſimas cavernas penetraſſet, ad quas Aër undique multiplicatus reſiliit. Et talia quidem objecta concava in ſummitate ſe non illico offerebant, idcirco ferè inſenſibiliter*

primùm ſonus repercutiebatur, donec deſcendendo antris & convallibus vicinior factus, ad eas fortiùs impegit.

CHAP. VI.

Obſervat. V. *Men uſually think not what the modification of the inviſible motion of Fluids may perform on the diſpoſed bodies of Animals.*

IN this Obſervation I expreſly mention *the diſpoſed bodies of Animals*, to intimate, that there is a peculiar aptitude required in thoſe Animals, or ſome particular parts of them that are to be ſenſibly affected by ſuch motions as we are treating of, which would otherwiſe be too languid to have any ſenſible operation on them.

It ſeems the leſs ſtrange to me, that continuing Sounds, and other ſomewhat durable Impulſes of the Air or other Fluids, ſhould have a manifeſt operation upon Solid bodies, when I conſi-

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der the multitude of ſtrokes that may in a very ſhort and perhaps ſcarce obſervable time, be ſuppoſed to be given by the parts of the fluid to the Conſiſtent body. For, though each of theſe ſingle would perhaps be too languid to have any ſenſible effect at all; it being opportunely and frequently repeated by the ſucceſſive parts of the fluid, as by ſo many little ſwimming hammers or flying bullets, they may well have a notable effect upon the parts of a body expoſed to their action: As may be argued from the great ſwing that may be given to Pendulums by a very languid force, if it ſucceſſively ſtrike the ſwinging body, when having finiſhed its excurſion, 'tis ready to return towards the Perpendicular; as alſo from the tremulous motion that is imparted even to the metalline ſtring of a Muſical Inſtrument, by the congruous motion the Air is put into by another trembling ſtring, (as there may be hereafter occaſion to declare.)

I remember, *Scaliger* tells a plea-

ſant ſtory of a Knight of *Gaſcony*, whom the ſound of a Bagpipe would force preſently to make water; adding, that a Perſon diſobliged by this man, and reſolving to be merrily revenged on him, watched a time when he ſate at a Feaſt ſo as he could not well get out, and brought a Bagpiper to play unawares behind him; which he did ſo unluckily, that the Muſick had preſently its wonted effect upon the poor Knight, to his great Confuſion and the laughter of the Company. On which occaſion I ſhall add, that I know a very Ingenious Gentleman, who has confeſſed to me, that the noiſe of a running Tap is wont to have almoſt the like operation upon Him.

'Tis a common Obſervation, that the noiſe that an ungreaſed cart-wheel makes in grating againſt the axel-tree, and the ſcraping of a knife upon a plate of ſilver or pewter, and ſome other ſuch brisk and acute Sounds, do ſo affect divers parts of the Head, as to produce that effect

that

that is commonly called *ſetting the Teeth on edge*; which whether it proceed from any commerce between the Auditory Nerves, and thoſe that are inſervient to the motion we have mentioned, I leave Anatomiſts to conſider. But theſe effects of acute ſounds are much leſs conſiderable than that which I elſewhere relate of an Ingenious Domeſtick of mine, who ſeveral times complained, that the tearing of brown paper made his Gums bleed: which argued that the ſound had an operation not onely upon the nervous and membranous parts, but the bloud and Humours themſelves.

Sir *Henry Blunt*, in his voiage to the *Levant*, giving an account of what he obſerved in *Egypt*, has, among other remarkable things, this paſſage: Many rarities of Living creatures I ſaw in *Gran Cairo*, but the moſt ingenious was a neſt of four-legged Serpents of two foot long, black and ugly, kept by a Frenchman, who when he came to handle them, they would not endure him, but ran and hid

in their hole; then would he take his Cittern and play upon it: They, hearing his Musick, came all crawling to his feet, and began to climbe up him, till he gave over playing, then away they ran.

This recalls to my mind, what some men of repute, and particularly the Learned *Kircherus*, relate concerning a great Fish, in or about the Streights that sever *Sicily* from *Italy*, which is said to be much affected with a peculiar kind of Tune, (harsh enough to Humane ears) by which the Mariners are wont to allure it to follow their vessels. And it may much strengthen the Conclusion maintained in this Chapter, if there be any certainty in the famous tradition, that the Lion is terrified and made to run away by the crowing of a Cock: I say, *if*, because though I doubt not but some peculiar kinds of Sounds, as well as of other sensible objects, may be particularly and exceedingly ungratefull to the Sensories of this or that peculiar kind of Animals, and consequently

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to the ears of Lions; yet a late French Traveller into the *Levant* gives me cauſe much to queſtion the matter of fact, affirming, that rowing along the brink of *Tigris* or *Euphrates*, (for I do not punctually remember which,) they were, for many hours in the night, terrified by Lions that attended them along the brink of the River, and would not at all be frighted by the frequent crowing of the Cocks that chanced to be in the paſſengers Boat. Of which unconcernedneſs of the Lions, our obſerving traveller took much more notice than the Lions appeared to do of the crowing of the Cocks. I might on this occaſion ſay ſomething of the received Tradition, that many ſleeping perſons will be more eaſily waked by being called upon by their own uſual names, than by other names, though uttered with a louder voice. But this it may ſuffice to have mentioned; nor will I here inſiſt on that more certain example of the operation of a Sound, which is af-

forded by the ſtarting of men or greater Animals, upon a ſurprizing, though not vehement, noiſe; though this oftentimes puts ſo many of the Spirits and Muſcles into motion, that the whole bulk of the Animal is ſuddenly raiſed from the ground, which perhaps it could not be by the bare counterpoiſe of ſome hundreds of pounds: This, I ſay, I will not in this place inſiſt on, becauſe the *Phænomenon* ſeems to depend rather upon the loudneſs or acuteneſs of the ſound, than upon any determinate modification of it, particularly relating to the *Animal* it ſelf.

But the eminenteſt Inſtance of the efficacy of peculiarly modified Sounds upon diſpoſed bodies, is afforded by what happens to thoſe which are bit by a *Tarantula*. For though the bitten perſon will calmly hear divers other tunes, yet when a peculiarly congruous one comes to be plaid, it will ſet him a dancing with ſo much vigour as the ſpectators cannot but wonder at, and the dancing will ſome-

ſometimes continue many hours, if the Muſick do ſo, and not otherwiſe. I know there are ſome that queſtion the truth of the things related of theſe *Tarantati*, (as the *Italians* call them,) and I eaſily grant, that ſome Fictions may have been ſuffered to paſs under the countenance of ſo ſtrange a Truth. But beſides the affirmations of ſome Learned men, (as well Phyſicians as others) my Doubts have been much removed by the Accounts I have received from an Ingenious Acquaintance of mine own, who at *Tarentum* it ſelf, whence the Inſect takes its name, and elſewhere, ſaw many bitten perſons in their dances, ſome in publick and ſome in private places, and amongſt the reſt a Phyſician, on whom the tune that fitted his diſtemper had the ſame operation as on the other Patients. And the Learned *Epiphanius Ferdinandus*, who practiſed Phyſick in *Apulia* and *Calabria* for many years, not onely delivers upon his own perſonal obſervation, ſeveral Narratives of the effects

effects of Muſick upon the *Tarantati*, but invites any that may doubt of the truth of ſuch Narratives to repair to him at a fit ſeaſon, undertaking to convince them by ocular Demonſtration.

I know a very honeſt and ſober Muſician, who has divers times affirmed to me, that he could at pleaſure, by playing a certain Tune, (which he acquainted me with, and which did not much move others) make a perſon (whom he named to me) weep, whether ſhe would or no. And I might add, that when I have been taking Phyſick, or am any thing feveriſh, the repetition of two verſes of *Lucan* ſeldom fails (as I have often tried) of producing in me a chilneſs, almoſt like that, but fainter, that begins the fit of an ague. But on this Inſtance I look not as a ſtrong proof of the Phyſical efficacy of Sounds; becauſe thoſe two verſes having been emphatically read, when divers years agoe I lay ſick of a ſlow fever, and could not reſt, they made

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ſo ſtrong an impreſſion on me, that whenever I am under a Diſcompoſure any thing near like that, that then troubled me, thoſe verſes revive, as 'twere, in my brain and ſome other parts that diſpoſition, or rather indiſpoſition, with which my firſt hearing of thoſe verſes was accompanied.

It may be the leſs admired, that the vibrating motion of the Air, that produces ſounds, ſhould have ſuch effects upon diſpoſed Organical bodies, ſince Light it ſelf, which either conſiſts of briskly moving *effluvia* far more ſubtile than aerial corpuſcles, or is propagated by the pulſe of a far more ſubtile body than Air, may have a notable operation upon diſpoſed bodies. For we commonly obſerve, that the Sunbeams, by beating upon the face or eyes of ſome that come ſuddenly out of a ſhaded place into the Light, preſently make them ſneeze; which you know is not done without a vehement motion of divers parts of the

the body. And though Colour be but a modification of Light; yet, beſides that 'twas anciently a practice, as the Hiſtory of the *Macchabees* informs us, to ſhew red objects to Elephants, to make them more fierce, 'tis a familiar obſervation, that red cloaths do offend and irritate Turky-cocks. And that is more remarkable, which is related by the very Learned Phyſician *Valeſius*, of a perſon that he knew, who, if he looked upon red objects, would not onely have his Eyes offended, but was ſubject to an effuſion of Humours in the neighboring parts.

CHAP.

CHAP. VII.

Obſervat. VI. *Men ſuſpect not what efficacy the Inviſible motions of Fluids may have, even upon inorganical bodies, upon the ſcore of ſome determinate Congruity or relation betwixt a peculiar Texture of the one, and the peculiar modification of the others motion.*

THough the Experiments delivered in the foregoing Chapter have, I preſume, ſufficiently manifeſted, that the modification given to the motions of the Air by ſonorous bodies may have conſiderable effects upon Animals, in whoſe organized bodies the curiouſly contrived parts have an admirable connexion with, and relation to, one another, and to the whole Symmetrical fabrick they make up; yet, I fear, it will ſcarce ſeem credible, that ſonorous motions of the Air, not very loud, ſhould find, even in bodies

bodies Inanimate and Inorganical; ſuch congruous Textures and other Diſpoſitions to admit their action, that even more languid Sounds, peculiarly modified, may ſenſibly operate upon them, and much more than ſounds that are louder and more vehement, but not ſo happily modified. To make this good by particular Experiments, I ſhall begin with that, which, though the effect may ſeem inferiour to that of moſt of the others, I judge fitteſt to manifeſt, that the produced motion depends upon the determinate modification of that of the impellent Fluid.

That a certain impulſe of Air, made by one of the Uniſon-ſtrings of a Muſical Inſtrument, may ſuffice to produce a viſible motion in another, is now become a known experiment; of the Cauſe and ſome unobſerved Phænomena of which I elſewhere more fully diſcourſe. But, that it may not be ſuſpected in this caſe, that the ſhake of the untouched ſtring is communicated to it by the propa-

propagated motion of the Instrument it self, to which the string, that is struck, is also fastned; I shall add, that, according to what I elsewhere relate, I found by trial purposely made, that a string of Wire, (which you will grant to be a more solid body than an ordinary Gut-string,) may be without another string brought to tremble by a determinate Sound made at a distance, which produced but such an impulse of the Air, as could neither be seen nor felt by the By-standers, nor would communicate any sensible motion to the neighbouring strings. 'Tis true, that in this case the string, in which the trembling was produced, was a single, long, slender and springy body, fastned at both ends to a stable one; and therefore it may seem altogether groundless to expect, that any thing like this effect should be by the same cause produced in bodies that do not appear so qualified. But, as we elsewhere shew, that a certain degree or measure of tension is in or-

der to this Phænomenon the principal Qualification, without which all the other would be unavailable; perhaps 'twill not be abſurd to enquire, *whether*, in bodies of a very differing appearance from ſtrings, the various Textures, Connexions, and Complications, that Nature or Art, or both, may make of the parts, may not bring them to a ſtate equivalent to the Tenſions of the ſtrings of Muſical Inſtruments, whereby divers of the mentioned parts may be ſtretched in the manner requiſite to diſpoſe them to receive a vibrating motion from ſome peculiar Sounds: And *whether* theſe trembling parts may not be numerous enough to affect their neighbours, and make, in the body they belong to, a tremulous motion diſcernible, though not by the Eye, yet by ſome other ſenſe. This conjecture or inquiry you will, I hope, have the leſs unfavourable thoughts of, when you ſhall have conſidered the following Experiments.

I remember, that many years agoe I found

I found by trial, that, if a ſomewhat large and almoſt hemiſpherical Glaſſe, though not very thin, were conveniently placed, a determinate ſound, made at a convenient diſtance from the concave ſurface of the Glaſſe, would make it ſenſibly ring, as a Bell does a while after it has been ſtruck. But this noiſe was the effect of a determinate ſound; for, though the voice were raiſed to a higher tone, or if the ſound were made louder, the ſame effect would not inſue. I remember alſo, that, ſome years after, I obſerved, that large empty drinking-glaſſes of fine white metal had each of them its determinate Tenſion, or ſome diſpoſition that was equivalent as to our purpoſe. For, cauſing the ſtrings of a Muſical Inſtrument to be variouſly ſcrewed up, and let down, and briskly ſtruck, we found, as I expected, that the motion of one ſtring, when 'twas ſtretched to a certain note or tone, would make one of the Glaſſes ring, and not the other; nor would the ſound of the

ſame ſtring, tuned to another note, ſenſibly affect the firſt Glaſſe, though perhaps it might have its operation upon another. And this Circumſtance is not, on this occaſion, to be omitted, that, after we had found the tone proper to one of the Glaſſes, and ſo tuned the ſtring, that, (I ſay) when that was ſtruck, the Glaſſe would reſound. Having afterwards broken off a part of the foot of the glaſs, yet not ſo much but that it continued to ſtand upright, the ſame ſound of the ſtring would no longer be anſwered by the Veſſel, but we were obliged to alter the tenſion of the ſtring, to produce the former effect. The Learned *Kircherus*, as I have been informed, ſomewhere mentions a correſpondence between ſome liquours and ſome determinate ſounds; which I ſuppoſe may be true, though the triall did not ſucceed with me, perhaps for want of ſuch accommodations for ſo nice an Experiment as I could have wiſhed, but could not procure: But if you can, you will oblige

lige me to make the trials ſo as to ſatisfie your ſelf and me, whether the agitation of the liquour be cauſed immediately by the motion of the Air, or be communicated by the intervention of the tremblings of the Veſſel.

An Artiſt famous for his skill in making Organs, anſwered me, that, at ſome ſtops of the Organs, ſome ſeats in the Church would tremble. But, becauſe I ſuſpected by his Relation, that the greatneſs of the ſound chiefly effected it, becauſe, when that Pipe, which they call the open *Diapaſon*, ſounds, the chair or ſeat, on which the Organiſt ſits, and perhaps the neighbouring part of the Organ trembles; I ſhall add, that I have divers times obſerved certain ſounds of an excellent Organ to make not onely the ſeat, I ſate on in the Church, tremble under me, but produce an odd tremulous motion in the upper part of my Hat, that I could plainly feel with my hands. And that, which makes me apt to believe that this effect depends upon the de-

terminate tone, rather than upon the loudneſs of the ſound, is, that I have oftentimes felt, and diligently obſerved ſuch a kind of motion in the upper part of my Hat, upon the pronouncing of ſome words in ordinary diſcourſe; in which caſe the effect could not with probability be referred to the greatneſs of the Sound, but its peculiar fitneſs to communicate ſuch a motion to a body ſo diſpoſed.

Nor is it onely in ſuch ſmall and yielding bodies, as Hats and Strings, that Sounds that are not boiſterous may produce ſenſible effects, for, if they be congruous to the Texture of the body they are to work on, they may excite motions in it, though it be either ſolid or very bulky: of which I ſhall here ſubjoyn a couple of inſtances.

An ancient Muſician affirmed to me, that, playing on a Baſe-viol in the chamber of one of his Scholars, when he came to ſtrike a certain Note on a particular ſtring, he heard an odd kind of jarring Noiſe, which he thought

thought at first had either been casual, or proceeded from some fault in the string; but, having afterwards frequent occasion to play in that same room, he plainly found, that the Noise, he marvelled at, was made by the tremulous motion of a Casement of a window, which would be made to tremble by a determinate sound of a particular string, and not by other Notes, whether higher or lower.

To this first Instance I shall add the second, which, I confesse, I was not forward to believe, till trial had convinced me of the Truth; and I scrupled it the rather, because, if the reflexion of determinate Sounds should appear to proceed from the peculiar kind of tremulous motion into which the parts of the resonant body are put, it may incline men to so great a Paradox, as to think, that such a motion of the Air as our Bodies do not feel, may produce a trembling in so solid a body as a Stone-wall of a great thickness. The Experiment or Observation it self I shall give you

in the ſame words I ſet it down ſome hours after I made it, which were theſe.

Yeſterday I went to ſatisfy my ſelf of the truth of what had been told me by an ancient Muſician, to whom I had been relating what I had obſerved of the effects of ſome determinate Sounds even upon Solid bodies, and of whom I enquired, if he had met with any thing of the like nature: taking him along with me, I found, that though the place be but an Arch, yet it would not anſwer to all notes indifferently, when we ſtood in a certain place, but to a determinate Note, (which he afterwards told me was *Ce fa ut* a little flatted,) to which note it anſwered very reſonantly, and not ſenſibly to others, which we made trial of, whether higher or lower than it; and, (which added to the ſtrangeneſs,) when I made him raiſe his voice to an Eighth, as conſonant as thoſe two Sounds are wont to be in all other caſes, the vaulted Arch did not appear

pear to us affected with the Note. The Muſician added, that he had tried in moſt Arches all about the City, and could not find ſuch a peculiarity in them, as being to be made reſonant by all Notes or Sounds indifferently that were ſtrong enough; and alſo, that as this Arch for this hundred years has been obſerved to have this property, ſo an ancient and experienced Builder informed him, that any Vault that were exquiſitely built, would peculiarly anſwer to ſome determinate Note or other.

CHAP.

CHAP. VIII.

Obſervat. VII. *Men look upon divers Bodies as having their parts in a ſtate of abſolute Reſt, when indeed they are in a Forced ſtate, as of Tenſion, Compreſſion,* &c.

THis Obſervation will probably ſeem paradoxicall. For, when an intire Body, eſpecially if it be of a ſolid Conſiſtence, and ſeem to be of an homogeneous or uniform matter, appears to be moveleſſe, we are wont to take it for granted, that the parts, which that body is made up of, are perfectly at Reſt alſo. But yet this will ſcarce be thought a reaſonable ſuppoſition, if we do but rightly conſider ſome obvious *Phænomena*, which may teach us, that, whilſt a whole Body, or the ſuperficies that includes it, retains its figure, dimenſions and diſtance from other ſtable Bodies that are near it, the Corpuſcles that compoſe it may have various

various and brisk motions and endeavours among themſelves. As, when a bar of iron or ſilver, having been well hammered, is newly taken off of the Anvill; though the Eye can diſcern no motion in it, yet the touch will readily perceive it to be very hot, and, if you ſpit upon it, the brisk agitation of the inſenſible parts will become viſible in that which they will produce in the liquour. Beſides, when the Lath of a Croſs-bow ſtands bent, though a man do neither by the Eye nor the Touch perceive any motion in the ſpringy parts, yet if the ſtring be cut or broken, the ſudden and vehement motion of the Lath, tending to reſtore it to the figure it had before it was bent, diſcovers a ſpringineſs; whence we conclude it was before in a ſtate of violent Compreſſion. And, though the ſtring of a bent Bow do likewiſe appear to be in a ſtate of Reſt; yet, if you cut it aſunder, the newly made extreams will fly from one another ſuddenly and forcibly enough

to

to manifeſt, that they were before in a violent ſtate of Tenſion. And on this occaſion I could add divers Inſtances taken not onely from the works of Art, but thoſe of Nature too, if they did not belong to another paper: But, one ſort of Obſervations 'twill be proper to ſet down in this place; becauſe in thoſe already mentioned, the bow and ſtring were brought into a violent ſtate by the meer and immediate force of man. I ſhall therefore add, that there are divers bodies, in which, though no ſuch kind of force appears to have antecedently acted on them, we may yet take notice of a ſtate of violent Compreſſion or Extenſion, and a ſtrong endeavour or tendency of the parts, that to the Eye or the Touch ſeem at reſt, to ſhrink or to fly out; and this endeavour may in ſome Caſes be more laſting and more forcible than one would eaſily ſuſpect or believe. But examples of this kind you muſt not expect that I ſhould give you out of *Claſſick* Authours,

thours, ſince in them 'tis like you have not met with either an Inſtance or a Conjecture to this purpoſe; but ſome few things that I tried my ſelf, and ſome others that I learnt by Inquiry from ſome Tradeſmen, whom I judged likelieſt to inform me, I ſhall briefly acquaint you with.

I have ſometimes obſerved my ſelf, and have had the Obſervation confirmed to me by the ingeniouſer Traders in Glaſs; That a Glaſs, that ſeemed to have been well baked, or nealed, (as they call it) would ſometimes, many days or weeks, or perhaps months, after it is taken from the fire, crack of its own accord; which ſeems for the moſt part to happen upon the ſcore of the ſtrong, but unequall, ſhrinking of the parts of the Glaſſe. And the Glaſs-men will tell you, that, if they take their Glaſſes too haſtily from the fire, not allowing them leiſure to cool by degrees, they will be very apt to crack. But I remember, that, to ſatisfy ſome Ingenious

genious men, I deviſed a way of exhibiting a much more quick and remarkable *Phænomenon* of that kind. Having made then, by a way I elſewhere teach, a flat Lump of metalline Glaſs, two or three or four times as thick as an ordinary Drinking-glaſs, I obſerved, as I expected, that, though it had been melted in a very gentle fire, its very fuſible nature needing no other, and though it were removed but very little from the fire, it was ſo diſpoſed to ſhrink upon a ſmall degree of Refrigeration, or rather abatement of Heat, that, before it was ſenſibly cold, it would crack with a noiſe in ſo vehement a manner, that, notwithſtanding the ponderouſneſs of the matter, which had been purpoſely laid upon a Level, parts of a conſiderable bulk, weighing perhaps ſome Drams, would fly, to a not inconſiderable diſtance from one another. And this Experiment I took pleaſure to make more than once. And if you will be content with an Inſtance

which,

which, though otherwiſe much inferiour, may not be unwelcome, for its being eaſily and readily made; I ſhall offer you one that I have often repeated. Take a piece of Copper, (if the Plate be thick, 'tis ſo much the better,) and, having throughly brought it to a red or white Heat among kindled Coals, take it from the fire, and when it begins to cool a little, hold it over a ſheet or two of white Paper, and you will perceive good ſtore of flakes to fly off, not without ſome little noiſe, one after the other, and ſometimes perhaps as far as the farthermoſt edges of the paper; which flakes or ſcales ſeem by their brittleneſs and colour, to be but parts of the ſurface of the metal vitrified by the vehement action of the fire, and afterwards by a too haſty refrigeration ſhrinking ſo violently, as to crack and leap from one another, like the contiguous parts of the ſtring of a Viol or other Muſical Inſtrument, that breaks by the moiſture of the Air. And on this

this occaſion I ſhall add, that, having afterwards inquired of an expert Artificer, that made metalline Concaves, about the ſhrinking of his mixtures of metalls, he confeſſed to me, that he uſually obſerved them to ſhrink upon Refrigeration. And the like I my ſelf have obſerved in Iron of a great thickneſs, and purpoſely fitted to a hollow body of metall, which it would not enter when it was ignited, though it would when 'twas cold. But to ſhew you by a notable Inſtance or two, both that Metals may ſhrink, and that they may doe ſo with a very conſiderable force, I ſhall add, that I found by inquiry, that the lately mentioned Artificer, after he had made ſome large Concaves of an unfit mixture of metals, and having removed them from the fire, had been very carefull to keep the cold Air from them, leſt they ſhould cool too haſtily, obſerved yet to his great loſs, that, when they came to be further refrigerated, they would (perhaps after three hours) crack with a great noiſe, though

though this metalline mixture were perchance harder than Iron, and three or four times as thick as common Looking-glasses. But the misfortune of another Tradesman afforded me a yet more considerable *Phænomenon*. For this excellent Artificer, whom I often employ, and with whom I was a while since discoursing of these matters, complain'd to me, that, having lately cast a kind of Bell-metall upon a very strong solid Instrument of Iron of a considerable superficial *Area*, though the metal were suffer'd in a warm room to cool, from about eight a clock on Saturday night till about ten or twelve on Monday morning, and were then (which is to be noted) considerably hot to the touch; yet it cool'd so far, that, shrinking from the Iron that would not shrink with it, the Bell-metall cracked in divers places with noises loud as the Report of a Pistoll, though the metall, he affirm'd to me, was an inch and half, or two inches thick. And the same

perſon ſhewed me a large Cylinder of Iron, about which, for a certain purpoſe, a Coat of Bell-metall had been caſt ſome days before, on which (Bell-metall) there was a crack near one end made by the coldneſs of the Iron, though the thickneſs of the Bell-metall, as near as I could meaſure it, exceeded an inch, and (as the Workman affirmed) an inch and a quarter.

Nor is it onely in ſuch mixtures as Bell-metall, which, though very hard, may be very brittle, but even in a metal that is malleable when cold, that the like Phænomenon may be met with, as I have been aſſured by another ingenious Artificer, of whom I inquired, whether he had taken notice of the ſhrinking of metalls; who affirm'd to me, that, having had occaſion to caſt about a Cylinder of Iron a ring or hoop of Braſs, he found to his trouble, that, when the metall began to cool, the parts ſhrunk from one another ſo as to leave a gaping crack, which he was fain to

fill

fill up with ſoulder quite croſſe the breadth of the ring, though this were above an inch thick.

I ſhould not, *Pyrophilus*, have in this Chapter entertained you with more Experiments of others than of my own, if I had the conveniency of living near Founders of metalls, as the Tradeſmen had whoſe Obſervations I have rected, and whoſe ſincerity in them I had no cauſe to queſtion. And both their Experiments and mine ſeem to teach, that a body may be brought into a ſtate of Tenſion, as well by being expanded and ſtretch'd by the action of the fire upon the minute parts, as by the action of an external Agent upon the intire body. And, to ſpeak more generally, the ſtate of violent Contraction and Compreſſion may not unfitly be illuſtrated by a Bow that is bent. For, as the Bow it ſelf is brought to a ſtate of Compreſſion by the force of the Archer, that bent it; ſo by the Elaſtical force of the bent Bow, the ſtring is brought into a violent ſtate

of Tenſion, as may be made evident by the cutting off the ſtring in the middle; for then both the Bow will fly ſuddenly outwards, and the parts of the ſtring will ſwiftly and violently ſhrink from one another. And according to this Doctrine, the effect of other bodies upon ſuch as are thus brought into, what men call, a Preternatural ſtate, is not to be judg'd barely according to uſual meaſures, but with reſpect to this latent Diſpoſition of the Patient: as, for inſtance, though the ſtring of a Viol not ſcrew'd up, will not be hardned by the vapours that imbue the Air in moiſt weather; yet a neighbouring ſtring of the ſame Inſtrument, though perhaps much ſtronger, being ſcrew'd up, and thereby ſtretched, will be ſo affected with thoſe vapours, as to break with noiſe and violence. And ſo when one part of a piece of Glaſs is made as hot as can be, without appearing diſcolour'd to the Eye, though a drop or two of cold water have no effect upon the other part of the

the ſame Glaſſe, yet if it touch the heated part, whoſe wonted extenſion (as I have elſewhere proved) is alter'd by the fire that vehemently agitates the component particles, the cracking of the Glaſs will almoſt always preſently enſue.

If againſt theſe Inſtances it be alledged, that it is poſſible to aſſign another cauſe of the ſeemingly ſpontaneous breaking of the bodies mention'd in this Chapter, than that which I have propos'd, it will not much concern this Diſcourſe to examine the Allegation; for, whatever the latent Cauſe of the Phænomena may be, the manifeſt Circumſtances of them ſuffice to ſhew, that bodies, which, as to ſenſe, are in a natural ſtate of Reſt, may be in a violent one, as of Tenſion, and may have, either upon the ſcore of the contexture of the parts among themſelves, or upon that of ſome interfluent ſubtile matter, or ſome other Phyſical Agent, a ſtrong endeavour to fly off or recede from one another; and that,

in divers bodies, the cauſe of this endeavour may act more vigorouſly than one would eaſily believe: and this ſuffices to ſerve the turn of this Diſcourſe. For I preſume that a perſon of your Principles will allow, that Local Motion muſt be produc'd by Local Motion, and conſequently, that, without a very ſtrong, though inviſible and unheeded one, ſuch hard and ſolid bodies as thick pieces of metall could not be made to crack.

I know not whether I may on this occaſion acquaint you with an odd Relation I had from a very honeſt and credible, as well as experienced, Artiſt, whom I, for thoſe reaſons, have ſeveral times made choice to deal with about precious Stones, and other things belonging to the Jewellers and Goldſmiths trades. For, conſidering with him one day a large lump of matter, which contained ſeveral Stones that he took for courſe Agats, and which were joyned together by a Cement, that in moſt places was harder than moſt ordinary

ry Stones, I perceived that there remained divers pretty large cavities in this Cement, which seemed to have contained such Stones as those that yet made parts of the lump. Upon which occasion he affirmed to me, that several of the Stones grew whilst they were lodg'd in those cavities. And when I told him, that, though I had been long of an opinion, that Stones may receive an increment after their first formation, yet I did not see how any such thing appeared by those we were looking upon: He gave me in many words an account of his Assertion, which I reduced to this, that the Stones he spoke of, did, after they were first formed, really tend to expand themselves by virtue of some Principle of growth, which he could not intelligibly describe; but that these Stones being lodg'd in a Cement extreamly hard, and therefore not capable of being forced to give way, their expansive endeavour was rendered ineffectual, but not destroyed: so that when afterwards these

Stones came to be taken out of the Cement wherein they were bedded, and to whose sides 'tis like they were not exquisitely congruous, the compreſt Stones, having their sides now no longer wedged in by the harder Cement, quickly expanded themselves, as if 'twere by an internal and violently compreſt spring, and would presently burſt asunder, some into two, and some into more pieces: of which he presented many to his friends, but yet had reserved some, whereof he presented me one, that I have yet by me, together with some of the mass, whose Cement I find to bear a better polish than marble, and to be very much harder than it. And, in answer to some questions of mine, he told me, that he had taken up these Stones himself, naming the place to me, which was not very far off, and that he observed all that he told me himself, and more than once or twice, and that I needed not suspect, as I seemed to doe, that 'twas the strokes employed to force the Stones

ſtones out of their Beds, that made them break. For, beſides that many of them, which (it ſeems) were not compreſt enough, did not break, ſeveral of thoſe, that did, were taken out, without offering them any ſuch violence, as that their burſting could with any probability be imputed to it.

CHAP.

CHAP. IX.

Obſervat. VIII. *One main cauſe why ſuch Motions as we ſpeak of are overlook'd, is, That we are ſcarce wont to take notice but of thoſe motions of Solid bodies, wherein one whole Body drives away another, or at leaſt knocks viſibly againſt it, whereas many effects proceed from the inteſtine motions produced by the external Agent, in, and among, the parts of the ſame body.*

THis Obſervation is like to be much more readily underſtood than granted, and therefore I ſhall offer by way of proof the following Experiments.

We cauſed in a large braſs Stopcock the movable part to be nimbly turned to and fro in the contiguous cavity of that part that was made to receive it, in that part of the Inſtrument that is wont to be kept fixt. And though this motion of the Key were

were made onely by the bare hand, yet in a ſhort time the mutual attrition of the contiguous parts of the Inſtrument made ſo brisk an agitation in the other parts, that the incaleſcence made the metal it ſelf to ſwell, inſomuch that the Key could no more be turned, but remained fixt, as if it had been wedged in, ſo that, to make it work as before, it was neceſſary by cooling it to make it ſhrink a little, and ſo take off the mutual preſſure of the Key, and the other part of the Stop-cock. Nor is this to be looked on as a caſual Experiment; for, beſides that it was made more than once, and is very analogous to ſome other trials of mine; I found, that a maker of ſuch Inſtruments complained to me, that he was ſeveral times forced to intermit his work, and plunge his Inſtrument in cold water, before he could, by grinding, adjuſt the Key to the cavity it ought to fit.

I preſume I need not take notice to you, that this Experiment confirms what

what I elsewhere mention of the dilatation of metals themselves by Heat, and therefore I proceed to the next Instance.

This is afforded by the known Experiment of passing one's wetted finger upon the orifice of a Drinking-glass almost fill'd with water. For, though the Eye does not immediately discern any motion, that, by reason of the pressure of the finger, is made by one part of the glass upon another; yet, That a vibrating motion is thereby produced, may be argued by the dancing of the water, especially that which is contiguous to the prest sides of the glass, by which 'tis oftentimes so agitated, that numerous drops are made to leap quite over, and others are tossed up to a good height into the Air. And that there may be considerable motions in the sides of the glass, whilst it does not break in pieces, we may probably guess by this, that, in Drinking-glasses artificially cut by a spiral line, both I, and others, have often

often found by trial, that, a glaſs being dextrouſly inverted and ſhaken, the parts will vibrate up and down ſo manifeſtly, as ſometimes to lengthen the glaſs, by my eſtimate, a quarter of an inch or more, and yet, the glaſs being ſet again upon its foot, it appeared that it had not been hereby at all injured.

That two pieces of Iron or Steel, by being ſtrongly rubbed againſt one another, will at length acquire a temporary Heat, is not hard to be believed: but that an edg'd Tool of hardened Steel ſhould, by having its edge rubbed againſt, have a manifeſt and permanent change made in its Texture, you did not perhaps ſuſpect; and yet, having had the Curioſity to cauſe ſome metals, and particularly Iron and Steel, to be turned by an excellent Artificer, I learned partly by his experience, and partly by my own, that the edge of the Steel-tool, with which he by degrees ſhaved off the protuberant parts of the metal, would be ſo heated and agitated,

that,

that, in no long time, if care were not taken to prevent it, the tool would be brought to look of blewiſh and yellowiſh colours, and, permanently loſing its former temper, would become ſo ſoft, as to be uſeleſſe for its former work, unleſſe it were again artificially hardened: and therefore, to prevent the trouble of tempering his tools again, this Artiſt, from time to time, dipt it, when it began to grow too hot, into a certain liquour, which he affirms, upon much experience to have a peculiar fitneſs for that purpoſe.

Nor is it always neceſſary that the body, that makes the parts of an inanimate body work conſiderably on one another, ſhould be either very hard, or impetuouſly moved. For, I remember, that, having once by me ſome ſhort bars of fine Tin, I reſolved to try whether, meerly with my naked hands, (which you know are none of the ſtrongeſt or hardeſt,) I could not procure a conſiderable internal Commotion among the parts;

and

and accordingly, laying hold on the two ends of the bar with my two hands, I ſlowly bent the bar towards me and from me two or three times, and having by this means broke or cracked it in the midſt, I perceived, as I expected, that the middle parts had conſiderably heated each other.

What uſe may be made of this Experiment in the ſearch of the hidden cauſe of Elaſticity, would be leſs properly conſidered in this place than in another. But ſince I have named that Quality, I ſhall take this riſe to intimate, that if the reſtitution of a ſpringy body, forcibly bent, proceed onely (as ſome Learned Moderns would have it) from the endeavour of the compreſt parts themſelves to recover their former ſtate, one may not impertinently take notice of the Elaſticity that Iron, Silver and Braſs acquire by hammering, among the Inſtances that ſhew what in ſome caſes may be done by a motion wherein the parts of the ſame body are, by

an almoſt unheeded force, put to act upon one another. But if Springineſs depend chiefly upon the pervaſion of a ſubtile matter, as the *Carteſians* would have it, then the Inſtances will properly belong to another Subject.

§ The foregoing Examples may alſo ſuffice to make out (what I am unwilling to refer to another Head) this ſubordinate Obſervation, That men are more uſually than juſtly prepoſſeſſed with an opinion, that nothing conſiderable is to be expected from the motion of a body againſt another, unleſs the former do make a manifeſt percuſſion or truſion of the latter. But, becauſe this prepoſſeſſion eſpecially prevails in caſes where the body that is by friction or attrition to affect the other, is it ſelf ſoft or yielding, I ſhall on this occaſion add a few Inſtances to remove this Prejudice.

An Artiſt, eminent for grinding of Optical glaſſes, confeſſed to me, that ſometimes when he went about

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to poliſh his broader glaſſes, though but upon a piece of Leather ſprinkled with Puttee, that friction did ſo heat or otherwiſe agitate the parts of the glaſs, as, to his great loſs, make it crack from the edge to the middle; which ſeemed the more ſtrange, becauſe we ſee, what intenſe degrees of Heat glaſſes will endure without cracking, if the fire be but gradually applied, as this Artiſt's glaſſes muſt have been gradually heated.

But I think it worth inquiry, whether in this caſe the whole work be performed by meer Heat, and whether there intervene not a peculiar kind of motion, into which ſome bodies are diſpoſed to be put by a peculiar kind of friction, which ſeems fitted to produce in manifeſtly ſpringy bodies, and perhaps in ſome others, (of which divers may be ſpringy that are not commonly taken to be ſo,) ſuch a vibrating or reciprocal motion, as may have ſome notable effects, that are not wont to be produced by

moderate Heats, nor always by intenſe ones themſelves. The trembling of the parts of a Drinking-glaſs, and the viſible vibration of the long and great ſtrings of a Baſe-viol, upon peculiar ſounds, may give ſome countenance to this conjecture. And that in ſome bodies there may be ſuch a tremulous motion produced, by rubbing them upon ſo ſoft a thing as Wool, or upon a piece of Cloath, I tried by this Experiment:

We caſt into a hollow Veſſel, very ſmooth within, and of an almoſt Hemiſpherical figure, ſeverall ounces of good melted Brimſtone, and having ſuffered it to cool, and taken it out, the Convex ſurface, as had been deſired, came off well poliſhed; then this conveniently ſhaped lump, which had (if I well remember) four or five inches in Diameter, being briskly rubbed in the ſame line forwards and backwards, upon a Cuſhion or ſome ſuch woollen thing, in a place free from other noiſes, I could, by holding my ear to it, and attentively liſtening,

ſtening, plainly hear a crackling noiſe made by the agitated parts, which continued a brisk, and, as I ſuppoſed, a vibrating motion for ſome time after the friction was ended.

That there may be a conſiderable Commotion produced among the internal parts of bodies, by rubbing them even againſt ſoft bodies, I have divers times obſerved, by the ſulphureous ſteams that I could ſmell, if, after having a little rubbed a lump of good Sulphur upon my Cloaths, I preſently held it to my noſe. Which brings into my mind, that I have had the like effect from much harder and cloſer bodies than Sulphur, when they were rubbed upon bodies that were ſo too. For having purpoſely taken hard Stones cut out of mens Bladders, and rubbed a couple of them a little againſt one another, they quickly afforded, as I expected, a rank ſmell of ſtale Urin.

That Diamonds themſelves will, by rubbing upon woollen cloaths, be made Electrical, ſeems to argue, that

even Their parts are ſet a moving: And that the Commotion reaches to the internal parts, I am the more apt to think, becauſe I have a Diamond, that, if I rub it well and luckily againſt my Cloaths, will, for a little while, ſhine or glimmer in the dark; which is the ſame Phænomenon that I elſewhere relate my ſelf to have produced in the King's larger Diamond, by giving it one brisk ſtroke with the point of a bodkin, where the Light that preſently appeared in the Gem, ſeemed not referrable to any thing ſo likely as the ſudden Commotion made in the internal parts of that peculiarly conſtituted Stone.

What a peculiar modification of motion, diſtinct from its degrees of *Impetus*, may doe in Fluid bodies, we have formerly in this Eſſay taken notice of. But perhaps it may be worth while to enquire, what kinds there are of it, and what effects they may have in the parts of Solid bodies themſelves. For I have obſerved,

ved, that though those Stones that the *Italian* Glass-men use are very hard, and, if I misremember not, have several times afforded me sparks of fire by Collision; yet, by rubbing them a little one against another, I found, that such an agitation was made in their parts, as to make them throw out store of fœtid exhalations: And 'tis possibly to the stony Ingredient that Glass owes the Quality I have observed in it, and elsewhere mentioned, of emitting offensive steams. And 'tis remarkable to our present purpose, that, though so vehement an agitation of the parts, as is given to Glass by Heat, when 'tis made almost red-hot in the fire, does not make it sensibly emit odours; yet barely by dextrously rubbing two solid pieces of Glass against one another, one may, in a minute of an hour, make those fixed bodies emit such copious steams as I found, not onely sensibly, but rankly, fœtid; though one would think those stinking exhalations very indisposed to be forced off, since they

were not expelled by the vehement fire, that the Glaſs long endured in the furnace where 'twas kept melted.

There are few things that ſhew better, both how the parts of Inorganical bodies communicate their vibrating motions to one another, and how brisk thoſe motions are, than that which happens upon the ſtriking of a large Bell with a Clapper or a Hammer. For though the ſtroak be immediately made but upon one part, yet the motion, thereby produced, is propagated to the oppoſite, and the ſucceſſive vibrations of the ſmall parts do, even in ſo ſolid and cloſe a body as Bell-metal, run many times round; as may appear by the durableneſs of the ringing noiſe, which ſeems plainly to proceed from the circularly ſucceſſive vibrations of the parts, which, unleſs they briskly tremble themſelves, can ſcarcely be conceived to be fitted to give the Air that tremulous motion, whoſe effect on the Ear, when the firſt and loud

loud noiſe, made by the percuſſion, is paſt, we call Ringing. And this motion of the parts of the ſounding Bell may be further argued by this, that, if the finger, or ſome other ſoft body, be laid upon it, the ſound will be checked or deaded, and much more, if a broad ſtring, though of a ſoft ſubſtance, be tied about it. And not onely an attentive Ear may often make us gueſs, that the ringing ſound is produced by a motion propagated circularly in the Bell, but this vibrating motion may ſometimes be alſo felt by the tremulous motion communicated by the trembling parts of the Bell to the finger, that is warily applied to it. That this motion paſſes in a round, from one ſide of the Bell to the other, ſeems manifeſt by the great difference of ſound, eſpecially in regard of ringing, that may be obſerved in a ſound Bell, and in a crack'd one; where yet all the matter and the former figure are preſerved, onely the intireneſs or continuity, which is neceſſary to the circu-

lation (if I may ſo call it) of the tremulous motion, is at the Crack ſtopt or hindred. And that the motion of the parts is very brisk, may be gueſſed partly by what has been ſaid already; but much more if that be true, which, not onely is traditionally reported by many, but has been affirmed to me by ſeveral Artificers that deal in Bells, who averred, as an experienced thing, That if a conveniently ſized Bell were bound about, any thing hard, with a broad ſtring, and then ſtruck with the uſual force, that it would otherwiſe bear very well; that percuſſion would break it, giving a diſorderly check to the brisk motion of the parts of the Bell, whereof ſome happening to be much more (and otherwiſe) agitated than others, the force of their motion ſurmounts that of their Coheſion, and ſo produces a Crack.

But, in regard great Bells are not eaſie to be procured, nor to be managed when one has acceſſe to them, I ſhall add, that I took the Bell of a large

large Watch, or very ſmall Clock made of fine Bell-metall, which had no handle or other thing put to it, ſave a little Bodkin or ſkiver of wood, whoſe point we thruſt into the hole that is uſually left in the middle of the *Baſis*; and this ſharp piece of wood ſerving for a handle to keep the Bell ſteady enough, we placed in the cavity of it, near the edges, (for that Circumſtance muſt not be omitted,) ſome black mineral Sand, or, in want of that, ſome ſmall filings of Steel or Copper, or ſome other ſuch minute and ſolid Powder, which yet muſt not be too ſmall, and then ſtriking moderately with the Key againſt the ſide of the Bell, we obſerved, (as we expected) that, whilſt it continued briskly ringing, it made many of the filings to dance up and down, and ſometimes to leap up, almoſt like the drops of Water, formerly mentioned to skip, when the brim of the Glaſs was circularly preſt by the wetted finger. Which prompts me to add, that, having put a middle-

ſized

fixed drop of water (for in this case the quantity is a considerable Circumstance) near the lower edge of the Bell, 'twas easie to make it visibly tremble, and be as it were covered over with little waves, by a somewhat brisk stroke of the Key on the opposite side. And this effect was more conspicuous, when a very large drop of water was placed near the edge, on the convex side of a hand-Bell, whose Clapper was kept from any where touching the inside of it. And to obviate their jealousie, that, not having seen the manner of the above-mentioned motion of the Sand, might suspect that 'twas produced by the impulse which the Bell, as an intire body, received from the percussion made by the Key, we several times forbare putting-in the filings, till after the stroke had been given; which satisfied the Spectatours, that the dancing and leaping of the minute bodies proceeded from the same brisk vibrations of the small parts of the Bell, which, at the same time striking

ſtriking alſo the Air, produced a ringing ſound, which might very well, as it did, out-laſt the skipping of the filings; the exceedingly minute particles of the Air being much more eaſily agitable, than the comparatively groſs and heavy Corpuſcles of the Powder. And this ſucceſs our Experiment had in a Bell, that little exceeded an inch and half in Diameter.

And here, *Pyroph.* I ſhall put an end to this Rhapſody of Obſervations, hoping, that, among ſo many of them, ſome or other will be able to engage you, if not to conclude, yet at leaſt to ſuſpect, that ſuch Local motions, as are wont either to be paſt-by unobſerved, or be thought not worth the obſerving, may have a notable operation, though not upon the generality of bodies, yet upon ſuch as are peculiarly diſpoſed to admit it, and ſo may have a conſiderable ſhare in the production of divers difficult *Phænomena* of nature, that are wont to be referred to leſs genuine, as well as leſs intelligible, Cauſes.

FINIS.

AN

Experimental Diſcourſe

Of ſome UNHEEDED

CAUSES

OF THE

Inſalubrity and *Salubrity*

OF THE

AIR,

Being a Part of an intended Natural Hiſtory of AIR.

LONDON,

Printed by *M. Fleſher*, for *Richard Davis*, Bookſeller in *Oxford*. 1685.

THE

Preface.

HAving heretofore had occasion to draw together under certain Heads, divers unpublish'd Observations and Experiments of my own, and some of other men, by way of Memorials for a Natural History of the Air; *I thought fit by more largely treating of two or three of the Subjects distinctly mention'd in my Scheme of Titles, to give a Semplar or* Specimen *of what may be done upon the other Heads of the designed History. Upon this ac-*

count I treated ſomewhat largely of the Salubrity and Inſalubrity of the Air, *as a Subject, which for the importance of it to Mens healths and lives, I thought deſerv'd to be attentively conſider'd, and have its Cauſes diligently inquir'd into. And having obſerv'd that among the ſix principal Cauſes of the healthfulneſs or inſalubrity of the Air, namely the* Climate, *the* Soil, *the* Situation *of the* Place, *the* Seaſons *of the Year, the* raigning winds *and* Contingencies *(whether more or leſs frequent) and eſpecially* Subterraneal Steams, *having I ſay obſerv'd that among theſe Cauſes there was* one, *viz. the laſt nam'd, about which, I thought I could offer ſomething, that I had not met with in the Books of Phyſicians that treat of it; I was thereby invited to ſet down my Thoughts and Obſervations by way of Conjectures, which I was made to believe would appear uncommon, and would*

would not prove useless. These Observations and Reflexions I referr'd for clearness and distinctions sake to four Propositions. But when I had gone thorough the three first, and made some progress in the fourth, being hinder'd by divers Avocations to make an end of it, I laid by the whole Discourse in a place which I thought a safe one, but when afterwards I had some opportunity to dispatch what remain'd, I found all the diligence I us'd to retrieve the entire Manuscript unsuccessfull. At this surprizing Accident I confess I was somewhat troubled; because whatever may be thought of the discursive part of those Papers, the Historical part contain'd divers matters of Fact, that I did not meet with in Books, nor can now distinctly remember, and will not perhaps be lighted on by even Physicians, or such Naturalists as derive their knowledge one-

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ly from them. 'Tis upon this consideration, that having afterwards met with many Papers that belong'd to most parts of the unhappy discourse, I thought fit to put them together in the best order I could, that I might not loose what might give some light to so important a Subject as the Theory of Diseases. And this course I the rather pitch'd upon, because before the Papers about the Salubrity of the Air, I miss'd two other of my Manuscripts, whereof the former contain'd a Collection of Medicinal things, and the second a defence of the Mechanical way of Philosophizing about Natural Things, as it respects Religion. And I remember'd that having formerly lost a Manuscript I was much concern'd for, I purposely made a noise of it, whence I suppos'd the Plagiary would conclude himself unable to make it pass for his. And in effect

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the Book was in a while after privately brought back, so that I found it laid in a By-place, where I had before as fruitlesly as carefully sought it.

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AN Experimental Diſcourſe Of ſome Unheeded CAUSES OF THE *Inſalubrity* and *Salubrity* OF THE AIR, &c.

THE ſixth and laſt thing upon which the Salubrity and Inſalubrity of the Air depends, is the impregnation it receives from Subterraneal *Effluvia*. And, though this be a cauſe not wont to be much heeded by Phyſicians themſelves; yet I take it to be oftentimes one of

the moſt conſiderable in its effects.

The *Effluvia* that paſs into the Air, may be diſtinguiſh'd into ſeveral ſorts, according to their reſpective Natures, as has been elſewhere ſhewn; wherefore I ſhall now only take notice of the differences that may be taken from *place* and *time*; upon which account we may conſider, that ſome of them ariſe from the *Cruſt* (if I may ſo call it) or more ſuperficial parts of the *Earth*; and others have a deeper Original, aſcending out of the lower parts, and as it were *Bowels*, of the *Terraqueous* Globe. And to this difference taken from place, I muſt add another, perhaps no leſs conſiderable, afforded by Time; which difference relates chiefly to the ſecond ſort of Steams newly mentioned.

Of the Subterraneal *Effluvia*, ſome are almoſt conſtantly or daily ſent up into the Air, and thoſe I therefore call *Ordinary Emiſſions*; and others aſcend into the Air but at times, which are not ſeldom diſtant

ſtant enough from one another, and thoſe I call *Extraordinary Emiſſions*; whether they come at ſtated times, and ſo deſerve the title of *Periodical*, or elſe uncertainly, ſometimes with far greater, ſometimes with far ſmaller intervals, and ſo may be called *fortuitous* or *irregular*. But, though I thought it might render what I am about to ſay more clear, if I made and premiſed the two foregoing diſtinctions, yet becauſe in many caſes, Nature does not appear ſolicitous to obſerve them, but at the ſame time imbues the Air with Steams referable to divers Members of theſe diſtinctions, I ſhall ſeveral times, though not always, take the liberty to imitate her, and conſider the *Effluvia* of the *Terraqueous Globe*, in the more general Notion, that they are ſo.

I know 'tis frequently obſerved, and uſually granted, that *Marriſh* Grounds, and *wet* Soils are wont to be *unhealthfull*, becauſe of the moiſt and crude vapours, that the ſtagna-

ting waters ſend up too copiouſly into the Air. And on the other ſide, *dry* Soils are, becauſe of their being ſuch, generally lookt upon as *healthy*. Nor do I deny, that theſe Obſervations do moſt commonly hold true; but yet I think, that beſides what can be juſtly aſcribed to the moiſt vapours, or dry Exhalations, we have been ſpeaking of; in many places the healthfulneſs and inſalubrity of the Air may be aſcribed to other ſorts of *Effluvia* from the Soil, than thoſe that act merely, or perhaps principally, as theſe are either *moiſt* or *dry*.

Proposition I.

TO deliver my Thoughts about this matter ſomewhat more diſtinctly, I ſhall lay them down in the four enſuing Obſervations or Propoſitions, whereof the firſt ſhall be this: *It ſeems probable that in divers places, the Salubrity or Inſalubrity of the Air conſidered in the general, may be*

be in good part due to ſubterraneal Expirations, eſpecially to thoſe that I lately call'd Ordinary Emiſſions. For in ſome places the Air is obſerv'd to be much more healthy, than the manifeſt qualities of it would make one expect: and in divers of theſe Caſes I ſee no Cauſe to which ſuch a happy Conſtitution, may more probably be aſcrib'd, than to friendly *Effluvia* ſent up from the Soil into the Air; which Particles either by promoting *tranſpiration* (that great inſtrument of health and recovery;) or by hindering the production, or checking the Activity, of Morbifick ferments; or by mortifying and diſabling ſome noxious Particles, that would otherwiſe infeſt the Air, or by other ways, that I ſhall not now ſtay to enumerate; may not a little contribute to keep the Bodies of thoſe that live in that Air, in that regular and deſirable ſtate, we call *Health.* I know indeed that 'tis generally thought, and often true, that Mineral Bodies do

ſend up Exhalations, hurtfull not only to Plants, but to Men; but when we mean Subterraneal things indefinitely, though (Men are wont to look upon them but ſlightly under a general confuſed Notion) we employ a word more comprehenſive than moſt men are aware of, there being a great variety, as well as multitude of Bodies, that Nature has lodg'd in her dark Store-houſes under the ſurface of the Earth. And of theſe differing ſorts of Bodies, though 'tis probable that the greateſt part are ſuch whoſe *Effluvia* are unhealthfull to Men, yet there may be others whoſe Emanations may be friendly to him; I have known it obſerv'd that over ſome Tin Mines in the Weſtern parts of *England*, not only Trees, but far more tender Plants, as Graſs, are wont to proſper and flouriſh, and (if I much miſremember not) I have ſeen verdent Trees growing juſt over a vein of another ſort of Mineral, that lay near the ſurface of the Earth: And 'tis like-

likewiſe obſervable about thoſe that conſtantly dig in thoſe Tin-Mines, that they do not lead a ſhort and ſickly life as in many others, but arrive at a great and vigorous Age. And an Ancient Poſſeſſor of ſome of theſe Mines being askt by me, whether amongſt the otherwiſe differing Exhalations that aſcended into the Air, he did not find a difference as to ſmell bad or good; he anſwer'd, that though moſt of thoſe viſible fumes had a ſmell that participated enough of Sulphur or Bitumen to be offenſive, yet ſome others were ſo far from being ungratefull, that they were well ſcented. And on this occaſion I remember, that not long ſince, a Friend of mine, and another *Virtuoſo*, being Partners in a chargeable Attempt to diſcover a Mine, in digging deep for it, they accidentally broke into a vaſt Subterraneal Cavern, into which, becauſe the Diggers would not venture to deſcend, one of theſe curious Gentlemen cauſed himſelf to be

let down, and there found the Air very temperate and refreſhing, and that he long breath'd it with delight, and on the floor, or Soil (which reach'd farther than he could diſcover) he found many and various Minerals moſt of them embryonated, or imperfectly form'd, and ſtore of a kind of Mineral Earth, whoſe ſmell was fragrant and very pleaſant both in his Judgment, and that of ſome Ladies. And though, when ſome of thoſe Minerals were brought to me, a ſmall lump of this Earth that was among them, had been kept ſo long in the Air, as to ſpend moſt of its Odoriferous Particles, yet the ſmell it ſtill retain'd, was, though but faint, yet pleaſing.

That from Foſſiles that lye hid under the ſurface of the Earth, and have a conſiderably large Spread, there may aſcend ſtore of wholſome *Effluvia* into the Air, ſeem'd to me the more probable by what I noted at my laſt being in *Ireland*, where, being invited by a Brother of mine

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to paſs ſome time in a Countrey houſe of his, to which there belong'd a very large Sheep-walk that produc'd ſhort, but excellent Graſs; I learn'd (and was eaſily perſwaded by ſome things I took notice of) that this place was juſtly reputed very healthfull, and this Salubrity of the Air, together with the ſweetneſs of the Graſs, ſome circumſtances invited me to aſcribe to *this*; That the Soil was ſuſtain'd by a large tract of Limeſtone, which I ſuppos'd to emit continual exhalations into the Air; which conjecture will perhaps with the leſs ſcruple be aſſented to, if I add that it has been long and generally obſerv'd, that as far as the Limeſtone extends, that tract of ground makes the Snow *that* falls on it thaw, or melt much ſooner, than it does on the Neighbouring Lands.

After I had made this Obſervation, I mention'd it in diſcourſe to an inquiſitive Perſon, that had ſeen and been employed about ſeveral Mines; and I asked him whether he had met with

with any thing of this kind; to which he anſwer'd me, that in *Derbyſhire*, at a place which he nam'd to me, he and others had obſerv'd, that a large tract of Limeſtone land was ſo warm (as they ſpeak) as to diſſolve the Snow that fell on it, very much ſooner than another great ſcope of Land, which was divided from it but by a glin, where the Soil did not cover Limeſtone, but Freeſtone.

Afterwards, diſcourſing of this Subject with an ingenious Perſon, that had viſited the *Hungarian*, and *Bohemian* Mines; he told me, that during his ſtay among the former, he often walked abroad with the Overſeer of them, a famous and experienc'd Mineraliſt, who delighted to breathe the freſh morning Air upon ſome Hills abounding with Minerals; that his Guide made him obſerve, that when they were over a tract of Land that afforded much of that noble Oar (which by a *German* Name he called *Rot-gulden ertz*) he found

found the ſmell to be pleaſing, and the Air refreſhing. And whereas, in paſſing over ſome other Mines, he found himſelf moleſted by offenſive fumes; he felt no ſuch effect, when he was upon that ſcope of ground under which there lay veins of *Cinnabar*, or, if you pleaſe, a Mine of *Quick-ſilver Oar*: And his ancient Guide told him, that next the *Rot-gulden ertz* before mentioned, the Soil containing theſe Cinnabarine veins, was that whoſe incumbent Air was the moſt eligible for pleaſantneſs and Salubrity. And I the leſs wonder, that in ſome places the ſubjacent Foſſiles ſhould impregnate the Air with wholſome *Effluvia*, becauſe I remember I had the Curioſity to ride many Miles, (though in the depth of Winter,) to ſee a ſcope of ground that was famous for a good Pottery; where, beſides many other Mineral Earths that I took notice of, there was a Pit or Groove, that reach'd, if I miſtake not, fifteen or twenty foot beneath the ſurface of the ground;

ground; whence they dug up a kind of white Clay, ſo richly impregnated with ſubtile and noble parts, that it afforded a Chymiſt or two of my Acquaintance (for I had my ſelf no opportunity to diſtill it) good ſtore of a Subtile Spirit, of a Volatile and Saline Nature, which upon trial they highly extoll'd for it's Cordial, and other Virtues in Phyſick; and which, by ſome peculiar Mechanical trials I made with it, I concluded to abound with a Volatile Salt, not unlike that of Urine or Hartſhorn. And ſince by this inſtance we ſee, that ſome unſuſpected Foſſiles may be enrich'd with Medicinal and Fugitive Salts and Spirits; it may reaſonably be ſuppos'd, that theſe aſcending into the incumbent Air, may highly conduce to the Salubrity of it. And the Curioſity I have had to examine Chymically ſome Boles, and other Bodies, which are wont to be unregardedly compriz'd under the confus'd notion of *Earths*, makes me ſuſpect, that

that there may be far more *Species* of Salubrious Foſſiles than many have yet taken notice of.

But peradventure you will much the more eaſily admit in general, that Subterraneal Tracts of great extent may for a very long time ſend up into the Air copious Expirations, not diſcernable by any of our ſenſes, nor commonly ſuſpected to be found in that Body, if you pleaſe to conſider with me (what I do not remember to have been taken notice of to this purpoſe) that the common Air we live in, and breathe, does always abound, and for many Ages has been impregnated, with the Copious Magnetical *Effluvia* of the Earth; which our induſtrious *Gilbert*, and after him ſome learned Jeſuits and others, have proved to be a great, though faint *Magnet*; and whoſe emanations, as they conſtantly ſtream through the Air, I have elſewhere by particular Experiments ſhewn to be capable of paſſing through the Pores of Glaſs it ſelf, and acting almoſt inſtantaneouſly

taneouſly, and yet manifeſtly, upon Bodies hermetically ſeal'd up in it. But, *though* from what has been ſaid it may be inferr'd, that 'tis not improbable the Salubrity of the Air in ſome places may be chiefly, or at leaſt in part, due to the wholſome Expirations of Subterraneal Bodies; *yet*, generally ſpeaking, the Air is deprav'd, in far more places than it is improv'd, by being impregnated with Mineral Expirations. And indeed, beſides that, among the Minerals known unto us, there are many more that are *noxious*, than that are *wholſome*; the power of the former to doe miſchief is wont to be far more efficacious, than that of the latter to doe good; as we may gueſs by the ſmall benefit men receive in point of health by the *Effluvia* of any Mineral, or other Foſſile, known unto us, in compariſon of the great and ſudden miſchief that is often done by the Expirations of Orpiment, Sandarach, and white Arſenick; for, though that ſold in Shops

is

is *factitious*, being made of Orpiment ſublim'd with Salt, yet it is found *Natural* in ſome *Hungarian*, and other Mines. On which occaſion, I remember that the ingenious Perſon lately mention'd to have with his Guide taken the Air upon the Hills of that Mineral Countrey, anſwer'd me, that, when his Guide and he walk'd over ſome veins of theſe noxious Minerals, he met with ſeveral Odorous Steams, which, though differing from one another, agreed in this, that they were all offenſive to him; and particularly, ſome of them by their unwelcome ſharpneſs, and others by giving him a troubleſome difficulty of reſpiration. I will not here urge thoſe ſulphureous ſteams, that ſo ſuddenly deprive Dogs of ſenſe and motion, in the Neapolitan *Grotta de Cani*; becauſe there the Exhalations are too much included, and as it were pent up: But it is very proper to allege for my preſent purpoſe the *Aorni* or *Averni*, which are mention'd

tion'd by good Authours to be found, ſome in *Hungary*, and ſome in other Countries; for in theſe places there aſcend out of the Earth ſuch noxious and plentifull exhalations, as kill thoſe Animals that draw in the Air they infect; and ſome of them are able to precipitate, even the Birds that fly over the Caverns that emit them. But there are a multitude of Places, where 'tis not ſo manifeſt that hurtfull exhalations aſcend into the Air, and yet they really do ſo: There being in many places whole tracts of Land, that near the ſurface of the Earth abound with Marchaſitical Minerals, as theſe do with a ſharp vitriolate Salt, which, together with the ill condition'd Sulphur that they alſo plentifully contain, aſcend into the Air, and render it corroſive. On which occaſion I remember, that for Curioſities ſake I took ſome Engliſh ſhining Marchaſite; and caus'd a pound of it to be diſtill'd in an Earthen Veſſel with a good fire, by which means, notwithſtanding it's dryneſs,

dryneſs, I obtain'd two or three ſpoonfuls of a Limpid Liquor, that ſmell'd very ſtrongly, like that which the *Helmontians* call *Gas Sulphuris*; and which appear'd manifeſtly to be of an acid Nature, both by the taſte, and by it's readily corroding, and diſſolving unbeaten Coral, even in the cold, to mention here no other Tryals that I made with it. And the Mineral afforded me, together with this Liquor, about an ounce and three quarters of inflammable *Sulphur*, part whereof aſcending (as may be gueſs'd) in the form of very agile Corpuſcles, theſe faſten themſelves all about to the inſide of the Receiver, and there compos'd divers thin Coats, or Films, as 'twere, of Sulphureous matter ſticking to one another; which at their firſt taking off, and for ſome time after, might be bent or folded like leaves of paper, but afterwards harden in the Air. Mineraliſts, and ſome other good Authours, mention divers Places as abounding with Mar-

chaſitical Foſſiles, but I am apt to think, they are far more common than is vulgarly taken notice of; for I have met with them where one would little expect them. And, though in *England* all our Vitriol (which is now plentifully vended into Foreign parts) be made of Vitriolate Stones, or Bodies that paſs for ſtones; yet that is not true which our Mineraliſts are wont thence to conclude, that there is no other Vitriolate or Marchaſitical matter in *England*: for a famous dealer in Foſſiles, having found a Mine, which he knew not what to make of, and therefore carefully conceal'd, addreſs'd himſelf to me, becauſe, he ſaid, he knew I would not betray or ſupplant him: and having at his deſire taken a private view of what he had diſcover'd, I preſently found it to be a vein, that lay at ſome depth under ground, and ran along (how far I know not) like a vein of Metalline Oar, (and for ſuch upon that account he miſtook it) conſiſting of a black

a black and heavy ſtuff, which upon a few eaſie trials I quickly found to be of a Vitriolate Nature; inſomuch that, ſomewhat to my wonder, I was able to make it yield in few hours ſtore of pure Vitriol, without any troubleſome or artificial preparation.

Proposition II.

It is probable that in divers places ſome **Endemical Diſeaſes** *do mainly, or at leaſt in part depend upon* **Subterraneal** *Steams.*

UNder the name of *Endemical Diſeaſes*, I do not compriſe thoſe onely that are very peculiar to this or that Countrey; as the *Plica* is ſaid to be to *Poland*, (whence it receives its name of *Polonica*;) or an odd kind of *Colique* in one part of *France*, (from which 'tis called *la Colique de Poictou*;) but alſo thoſe that are more riſe in ſome Coun-

tries than in moſt others; ſuch as *Agues* in *Kent*, and in that part of *Eſſex* they call the *Hundreds*; the Conſumption (though that be an ambiguous name) in *England*, whence Foreign Phyſicians call it the *Tabes Anglica*; and *Fluxes* of the Belly in *Ireland*, where they are ſo riſe as commonly to paſs under the name of the *Countrey Diſeaſe*.

That theſe *Endemical*, or (if we may ſo call them) *Topical* Diſtempers, do in *many places* proceed from ſome exceſſive Heat, Moiſture, or other manifeſt quality of the Air; from bad Diet, vulgar Intemperance, and other Cauſes that have little or no connexion with *Subterraneal Reeks*, I readily grant. But, that in *ſome places* the *Endemical Diſeaſe* may either be principally *caus'd*, or much *fomented*, by noxious *Effluvia*, I am enclin'd to ſuſpect upon the following grounds.

1. There are ſome places, in which the Endemical Diſeaſe cannot be probably imputed to any manifeſt Cauſe;

Cauſe; as he may perceive that ſhall conſider how often it happens, that the Cauſes which are aſſign'd of ſuch Diſeaſes, if they were the true ones, muſt produce the like Diſtempers in many other places, where yet it is notorious that they are not *Endemical.*

2. That Subterraneal Bodies may ſend up copious Steams, of different kinds, into the Air, has been already made out.

3. It has been alſo ſhewn, that the Matters that ſend up theſe *Effluvia*, may be of a large extent. And I remember on this occaſion that I have ſometimes obſerv'd, and that in more Countries than one, a whole tract of Land that abounded with Minerals of one kind; and within no great diſtance, as perhaps a Mile or a League, another large tract of Land, whoſe Subterraneal part abounded with Minerals of a very differing ſort.

4. We have alſo above declar'd, and 'tis highly probable from the

nature of the thing it ſelf, that thoſe copious ſteams (Saline, Sulphureous, Arſenical, Antimonial, *&c.*) that impregnate the Air, may very much conduce to make it hurtfull to a humane body, in the way requiſite to produce this or that determinate Diſeaſe: as I not long ſince related from the Chymiſt that viſited the *Hungarian* Mines, that in ſome places he found the Reeks aſcending from them into the Air (though in an elevated place, and expos'd to the Winds) make him as it were Aſthmatical, and give him a troubleſome difficulty of Reſpiration. And here let me add an Obſervation, which perhaps will not be thought fit to be ſlighted by Phyſicians: namely, that ſome parts of the ſubſtance of the Air (for I ſpeak not of its Heat, Coldneſs, or other ſuch Qualities) do not onely affect humane bodies, or at leaſt many Individuals among them, as they are taken in by Reſpiration, but as they outwardly touch the Skin: and the

skin

Skin being (as I have elſewhere ſhewn) full of Pores, and thoſe perhaps of different ſizes and figures, thoſe Corpuſcles that get in at them may have their operation, even upon the moſt inward parts of the body. To make this more clear and probable, becauſe 'tis a thing of importance, I deſire theſe things may be obſerv'd.

1. That when I ſpeak of the Air, I do not in this place underſtand that Air, which I elſewhere teach to be more ſtrictly and properly ſo call'd, and to conſiſt of *ſpringy* Particles; but the Air in its more vulgar and laxe ſignification, as it ſignifies the Atmoſphere, which abounds with vapours, and exhalations, and in a word with Corpuſcles of all ſorts, except the larger ſort of ſpringy ones; and many of them may be ſo ſmall, and ſo ſolid, or ſo conveniently ſhap'd, as to get entrance at ſome of the numerous Orifices of the minute or miliary Glandules of the Skin, or at other Pores of it.

Thus, though paper be not pervious to the uncompreſs'd elaſtical parts of the Air, yet it may be eaſily penetrated by other Corpuſcles of the Atmoſphere: for I remember, I have for Curioſities ſake prepar'd a dry body, out of a ſubſtance belonging to the Animal Kingdom, which beinglapt up in paper, would, without wetting or diſcolouring, or any way ſenſibly altering it, paſs in a trice through the Pores of it in ſuch plenty, as to have not onely a viſible, but a manifeſt operation on bodies plac'd at ſome diſtance from it. And though a bladder almoſt full of Air, having its neck well tyed, be held near the fire in various poſtures, the elaſtical Air, though rarefied, or attenuated by the heat, will rather burſt the bladder, (as I have more than once found) than get out at the Pores, yet we have often made a certain ſubſtance, belonging to the Mineral Kingdom, that, if a bladder were wet or moiſt, (as the Skins of living Men are wont to be) would readi-

ly

ly pervade it, and have a ſenſible operation, even upon ſolid bodies plac'd within it. This Experiment (that I can repeat when I will) is therefore the more conſiderable to our preſent purpoſe, becauſe in the bladder of a dead *Animal*, the Poroſity may be well ſuppos'd to be much leſs than it was in the Animal when alive; in which ſtate the parts of the humane body are much more perſpirable than one would eaſily believe, partly becauſe of the heat that is continually diffus'd from the heart, and partly becauſe of the copious ſteams that are in perpetual motion, and keep the parts warm, moiſt and ſupple: And it is not to be pretermitted in our preſent inſtance, that the bladder of Urine conſiſts not of a ſingle Membrane, and is probably of a ſtronger texture, by reaſon of the ſubtile ſalt liquor it is inſtituted to contain, than many another Membranes of the body, or the Epidermis. And this is the firſt thing I would have noted.

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The next is, that, whereas in the Inſtances newly recited, and ſome others that are by and by to be mention'd, the effects were produc'd when the ambient Air, impregnated with Mineral Corpuſcles, had but a very ſhort time (perhaps not many minutes) to work upon the bodies expos'd to it: In thoſe Countries that are very ſubject to Endemical Diſeaſes, the Inhabitants are wont to live all the year long, and perhaps during their whole life, expos'd to the action of the vitiated Air: and how much a far ſhorter time will ſerve, to make the Corpuſcles that rove in the Air, penetrate into bodies of no very cloſe contexture, may be gueſs'd by the breaking even of the bigger ſtrings of Lutes and Vials, by the numerous (though inviſible) vapours, that get into them in rainy weather; and much more by the effects of ſuch vapours, when inſinuating themſelves in ſwarms into the Pores of a Rope, they ſhorten it ſo forcibly, as to enable it, by ſhrinking

king it ſelf to lift up and keep ſuſpended conſiderable weights, as I have elſewhere ſhewn by tryals purpoſely made. Theſe things may render it probable, that, *though* in a ſmall compaſs of time the noxious *Effluvia* that rove in the Air, may be too thinly diſpers'd in it, to inſinuate themſelves in any conſiderable number at the Pores of the Skin; *yet*, by reaſon of the continual contact of the Air, (eſpecially as to the Face, Hands, and ſome other parts) which may laſt day and night for many months, or perhaps years, there may be opportunity for a conſiderable number of morbifick Particles, to inſinuate themſelves into the cutaneous Pores.

3. And thus having once got entrance, they may by the capillary Veſſels that reach to, or terminate at the Skin, paſs on to ſomewhat larger Veſſels; and ſo may get into the maſs of bloud, and by its Circulation be carried to all the parts of the body; and ſo be enabl'd both to de-

deprave the bloud, and other juices themſelves, and to gain acceſs to any determinate part of the body, which their peculiar ſhapes, figures, *&c.* qualifies them to produce ſome particular Diſtemper in. This whole Doctrine may be made more probable, by what experience ſhews of the virtues of certain *Plaſters*, eſpecially *Mercurial ones*, in Diſtempers that are not at all, or at leaſt are not chiefly *Cutaneous* ; and (which comes more home to our Argument) of the efficacy of *Periapta*, and *Appenſa*, ſuch as *Piony-root*, *Bloud-ſtone*, *Lapis Nephriticus*, *Quick-ſilver* in a Quill, a *dry'd Toad* in a Ceſnet Bag, *&c*, whereof, though many anſwer not the Characters that are wont to be given of them, yet ſome of them, experience has convinc'd me to be of greater efficacy than I expected : And much more activity may be preſum'd to be, in divers noxious *Effluvia* from *Subterraneal Bodies* ; as may be gather'd from the effects of the Mercurial Girdles, that ſome unwary

wary perſons wear to cure the Itch; and from what I elſewhere relate of the fits of the *Colicque*, often produc'd in a Friend of mine by the *Effluvia* of maſſes of *Loadſtone*. And this laſt example may ſerve for a proof of another part of our *Hypotheſis*, by ſhewing that *Mineral Effluvia*, may not onely be noxious in a general way, but may produce this or that determinate Diſeaſe. That *Arſenical Appenſa*, though much extoll'd by divers *Phyſicians* themſelves, and ſold dear by *Empyricks*, as (if worn near the Heart) wonderfull *Amulets* againſt the *Plague*, have (eſpecially in ſome perſons and circumſtances) produc'd ſome of the noxious effects of *Arſenical Poyſons*, and particularly caus'd in ſome great faintneſs and diſpiritedneſs, I find by the Teſtimony of divers eminent Phyſicians. To which I ſhall add a remarkable one, which may probably be referr'd partly to this third Obſervation, as well as to what I lately deliver'd about the bad effects

of

of *Mineral Exhalations*, breath'd in with the Air they vitiated: and I the rather mention this Caſe, becauſe 'tis not onely an odd one, but is a conſiderable Argument to ſhew, that noxious *Mineral Expirations* may manifeſtly produce a determinate Diſtemper in unlikely parts of the body. The Obſervation is this; I knew, and on ſome occaſions employ'd, a *Chymical Laborant* that fanſi'd that he could make a rare Medicine out of *red Arſenick*, (as ſome call what others ſtyle *Sandarach*,) which is thought to differ little from common *Orpiment*, ſaving its being much higher colour'd: this *Laborant* then working long and aſſiduouſly upon this Mineral, and rubbing it frequently in a Mortar, came divers times to me; and complain'd of a *diſaffection* he thence contracted in the *Organs of Reſpiration*; for which I gave him ſomething that happen'd to relieve him; which encourag'd him to complain to me of another Diſtemper, that, though not

not so dangerous, did often very much molest him: which was, that when he was very assiduous in the preparation of his *Sandarach*, it would give him great *Pains*, and (if I misremember not) some *Tumours* too, in his *Testicles*: And this, for ought I know, happen'd to him as long as he was earnest about that Process; for the Medicines that had reliev'd him in his other Distemper, did not remove this: and I having occasion to go for a while into the Countrey, found him gone at my return. It may strengthen the Conjecture lately propos'd, of the possible insinuation of *Effluvia* that rove in the Air, at the Pores of the Skin, if I add that I have had the Curiosity to enquire of more than one Traveller, that had visited the famous *Pico* of *Tenarif* (at whose upper part there are found scatter'd parcels of *Sulphur*, and divers manifest tokens of a *Vulcan*) whether the *Sulphureous Steams* (that I suppos'd to be copious near the top of the Moun-

Mountain) did not work upon the *ſilver* Money they had in their Pockets, and diſcolour it: to which he anſwer'd that 'twas no uncommon Obſervation, to find at mens return from viſiting the top of the Hill, that the Money they carried about them was blackn'd, and that he himſelf had particularly obſerv'd it to be ſo: which might eaſily gain credit with me, who have divers times made a preparation of *Sulphur*, which, even in the cold, ſends out exhalations ſo penetrant, that, having for tryals ſake put ſome pieces of Coyn (which ought not to be Golden) into a Leather Purſe; they were able, and that in not very many minutes, to diſcolour manifeſtly the Money, in ſpite of the interpoſition of the Purſe that contain'd it. But I had a more conſiderable inſtance of the efficacy of the Sulphureous Expirations of the *Pico* of *Tenarif*, by a ſober Perſon that is one of the chief Directours of the famous *Eaſt-India*-Company of *London*; who, being

being queſtion'd by me about ſome circumſtances of his Journey to viſit the top of that ſtupendious Mountain, anſwer'd me, that among other effects the Sulphureous Air had upon him, (who is of a very fine complexion) he found at his return to the bottom, that his light-colour'd Hair had manifeſtly changed colour, and was in many places grown forked at the ends. Theſe Obſervations may make it probable, that *Mineral Exhalations* may not only affect humane Bodies, as they are drawn into the Lungs with the Air they ſwim in, but as they inſinuate themſelves into the Pores of the Skin.

One conſiderable Objection I foreſee may be made, againſt the Propoſition I have been all this while endeavouring to render probable; namely, that 'tis ſcarce conceivable, that in ſo many Ages as *Endemical Diſeaſes* have afflicted ſome Countries, the Subterraneal Matter, to which I do in great part impute ſome of them, ſhould not be

waſted and ſpent. I might perhaps on this occaſion move a doubt, whether we have had ſuch continued accounts of the temperature of the Air, of all the Countries where Diſeaſes are now *Endemical*, as to know that they have been always ſo; and that ſome of thoſe Diſeaſes have not been worn out here or there, and ſome others have not of later Ages begun to appear in this or that place. But contenting my ſelf at preſent to have hinted this Queſtion, I ſhall not ſtay to diſcuſs it; but proceed to offer three things, by way of direct anſwer to the Objection.

1. And firſt, I think it very poſſible, that divers Subterraneal Bodies that emit *Effluvia*, may have in them a kind of propagative or ſelf multiplying power: I will not here examine, whether this proceed from ſome ſeminal Principle, which many Chymiſts and others aſcribe to Metals, and even to ſtones, or (which is perhaps more likely) to ſomething analagous to a Firment, ſuch as in Vege-

Vegetables enables a little sour dough to extend it self through the whole Mass; or such, as when an Apple or Pear is bruis'd in one part, makes the putrify'd part by degrees to transmute the sound into it's own likeness; or else some maturative power, whereby an inanimate Body may gradually admit of such a change, or acquire such Qualities, as may be in Mens estimate perfective of it, and perhaps give it a new denomination; as *Anana's* in the *Indies*, and Medlars, and some other fruits here in *Europe*, do after they are gathered, acquire (as it were, spontaneously) in process of time, a consistence and sweetness, and sometimes Colour and Odour, and in short such a state as by one word we call *maturity* or *ripeness*: and so some Metalline Ores, and some Mineral Earths themselves, have been observ'd by Mineralogists, to acquire in tract of time such a change, as to afford some Metal or other Body, which either it did not afford before, or at least did not afford

ſo copiouſly, or ſo well qualify'd. This I have purpoſely made out in another Paper: and the Obſervation particularly holds as to *Niter*, which is thought to be the moſt Catholick Foſſile we have; and to be at leaſt one of thoſe Foſſiles, that do the moſt plentifully emit *Effluvia* into the Air.

2. When I conſider, that even in thoſe Mines that are accounted deep ones, the Spades of Men are not wont to reach to the ten thouſandth part of the thickneſs of the Earth, between its Surface, and its Centre, which yet is but its Semi-diametre; I cannot but confeſs, that we know very little of the Nature or Conſtitution of the lower part of the Terreſtrial Globe; ſince we know little or nothing experimentally, of what lyes beneath that Comparatively very thin Cruſt or Scurf, (if I may ſo call it) that Humane Induſtry has been hitherto confin'd to. And upon this account I do not think it abſurd to ſuſpect, that from the lower Subterraneal

raneal Regions there may be, either continually, or periodically, emitted into the Region of Mines (if I may so call it) great store, and variety of Mineral Exhalations, which may continually repair the loss of those, that from time to time ascend out of the Fossile Region (as I may also call that of Mines) into the Atmosphere. But the things I could alledge to Countenance this Conjecture, must not be insisted on in this place. Therefore I proceed to consider.

3. That Bodies so heavy, and consequently so abundant in parts of solid matter crouded together, as Minerals, and other Fossiles are wont to be, may well be suppos'd capable, without destructively wasting themselves to emit store of such minute Particles as *Effluvia*, for an exceeding long time. This will be easily granted by him that shall consider the particulars laid together in a small Tract, that I purposely writ, about the admirable Subtilty

of *Effluvia*. And 'twill be the more eaſily believ'd, if it be conſider'd how long ſome Load-ſtones, ſever'd from their Mine, have been kept in the Air without any notable, or perhaps ſo much as ſenſible diminution of their Virtue. And this brings into my mind what an eminent Phyſician, who was skill'd in Perfumes, affirm'd to me about the durableneſs of an Effluviating power, that was not natural to a Metal, but adventitious, and introduc'd by Art: for he aſſur'd me that he had a Silver Watch-caſe, that had been ſo well perfum'd, that though he uſually wore the Watch in his Pocket, it continued to be well ſcented ſixteen years. The ſame Perſon had a way of perfuming factitious Marble quite thorough, whoſe grateful Scent he affirm'd would laſt exceedingly; and of this perfum'd Marble he preſented me a Ball, which having been ſome months after gotten from me by a great Lady, I was diſabled from obſerving the durableneſs of the fragrancy. I

I might perhaps be thought wanting to my Cauſe, if, before I diſmiſs the Propoſition I have been all this while diſcourſing of, I ſhould not obſerve, that Subterraneal *Effluvia* may contribute to *Endemical Diſeaſes*, not only as they vitiate the Air, that Men breathe in, or are immediately touch'd by; but as they may impregnate or deprave the Aliments that men feed upon. For firſt, they do mingle themſelves with the *water*, which either men drink it ſelf alone, (as is the Cuſtome with many Nations, and of ſome men in moſt Nations; or make of it their Bear, Ale, or other factitious drinks, prepar'd of *Water* and Barley, Oats, Rice, *&c.* That divers Springs, and other Waters are imbued with Mineral Corpuſcles, may be judg'd by *ſome* of the Medicinal Springs: for, though divers *Acidulæ* and *Thermæ* afford good ſtore of palpable Sulphur or Salt, yet all do not; and having purpoſely examin'd a famous one, I could with a pair of nice Scales

ſcarce diſcover any ſenſible difference at all between the *Medicinal Water*, and the *common Water* that was to be met with thereabouts. And that which impregnated this, and which I found by tryal on my ſelf, and ſome other Bodies, enabl'd it to work very manifeſtly like a Mineral Water, was a ſort of Corpuſcles ſo minute and ſubtile, that if the Bottles were not kept well ſtopt, they would in a ſhort time vaniſh, and leave the Liquor diſpirited. Experience has aſſur'd me, that there are ways of making common water violently and hurtfully operative upon Humane Bodies, though its ſenſible qualities would not make one ſuſpect any change in it: but the ill uſe that bad men may make of ſuch Liquors, makes me forbear to expreſs my ſelf more clearly: nor is it neceſſary that I ſhould add any thing to confirm the propos'd conjecture, ſave what may be inferr'd from theſe two Particulars; the firſt whereof is the ſcarce at all ſenſible change

change that may be made in water, and ſome other Liquors, that are made ſtrongly Emetick by *Crocus Metallorum*, and by Antimony vitrify'd without addition; and the ſecond may be taken from thoſe *Averni*, whence there continually aſcend ſuch pernicious Exhalations, as in ſome places intoxicate or kill even the Birds that fly over thoſe poyſonous vents; for if ſuch Exhalations, or even far leſs deadly ones, ſhould (as they may be reaſonably ſuppos'd, ſometimes to do) meet wit h either running or ſtagnant Waters in their aſcent, there is little doubt to be made, but they will impregnate them, and make them noxious. And on this occaſion we may pertinently recall to mind, what I have formerly deliver'd about a place upon the Borders of *Lancaſhire*, where the Water and Mud of a Ditch is ſo copiouſly impregnated with Subterraneal Exhalations, (whether they be bituminous, ſulphureous, or of ſome un-

unknown kind) that they may eaſily be fir'd at the ſurface of the Water, or Earth, and made to burn like a Candle, as an ingenious man did at my Requeſt ſucceſsfully try.

But there is another account, upon which the *Effluvia* of the lower parts of the Earth may have a greater ſtroke in producing of Endemical Diſeaſes; namely, as they mingle with the Water, and other Liquors that are neceſſary to the nutrition and growth of Plants; and, by depraving thoſe juices, make the vegetables that are nouriſh'd by them unhealthy for the men that eat them, or make drinks of them: and theſe noxious Exhalations may be ſuppos'd in many places to impregnate the juices of the Earth, much more copiouſly than they do the running or ſtagnant Waters lately ſpoken of: becauſe the difficulty of pervading the Earth in their aſcent, may ſo long check them, as to make them very numerous in a ſmall ſpace, and perhaps make them convene into Bodies, ſo far of a Saline Nature as to

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be diſſoluble either in common Water, or ſome other Subterraneal Liquor; by whoſe help, as by vehicles, they may inſinuate themſelves into the roots of Plants, and be thence conveyed to other parts. Divers things might be alledg'd to keep this conjecture from being improbable, if I had leiſure to inſiſt on them: but I I ſhall now only mention two things that on this occaſion come into my mind: the firſt whereof is, that enquiring of a famous Chymiſt, who liv'd in a Countrey abounding with Mines of Vitriol, whether he did not obſerve, that the Oaks growing over them were more ſolid, or heavy, than thoſe Trees are elſewhere wont to be; he anſwer'd me, that he did, and that the difference was remarkable: The other is, that the parts of ſome Minerals, (probably by reaſon of the ſmallneſs and ſolidity of the Corpuſcles they conſiſt of) are capable of inſinuating themſelves very plentifully into the pores of growing Vegetables, without being really ſubdu'd by what

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Philoſophers are pleas'd to call the *Concocting Faculty* of the Plant; and, inſtead of being aſſimilated by the Vegetable, they retain their own Mineral Nature, and upon the receſs or evaporation of the juice that ſerv'd them for a vehicle, may ſometimes diſcover their being Mineral, even to an unaſſiſted Eye. For I remember I have ſeen a piece of a Vine, that grew not far from *Paris*, which being broken, I perceiv'd a multitude of the internal Pores of the root, and, if I miſtake not, part of the Trunk alſo, to be ſtuff't with Corpuſcles of a Marchaſitical Nature; as manifeſtly appear'd by their Colour, and their ſhining luſtre, and alſo by their weight.

There goes a Tradition among learned Men, that the leaves of Vines that grow in ſome places of *Hungary*, whoſe Mines afford Gold, are as it were gilt on the lower ſide, by aſcending Exhalations of a Golden Nature: whether this be true or no, I ſhall not take upon me to determine: but I remember, that having made enquiry about

about the truth of it, of a very ingenious Traveller, whose Curiosity led him to visit heedfully those famous Mines: he told me, that he did not remember he had observ'd what is reported about the Leaves of the Vine: but he knew very well that at *Tockay* (a place that affords the famousest Wine of *Hungary*, and indeed the best I have drunk) very many of the kernels of the Grapes would appear guilt over, as it were, with leaf gold. To what has been already discours'd, may be added, that since men are not wont to feed upon either Beasts, or Birds of prey, as carnivorous Animals usually are, but upon such as live upon Grass, or Seeds, or other vegetable substances, and drink nothing but fair water; the noxious exhalations that make vegetables, and water unwholsome, may by *their* means have a very bad influence upon Sheep, Cows, Deer, Pigeons and other Animals that feed upon such deprav'd vegetables, and drink such noxious waters; and consequently may be very hurtfull to those

thoſe men that feed upon ſuch Animals, and may by the deprav'd aliment they afford, determine them to an Endemical Diſeaſe, ſuch as that vitiated nutriment is fitted to produce.

Perhaps it will not ſeem improper to add on this occaſion, that 'tis poſſible that in certain places the latent Minerals may be of ſuch a Nature, as that their *Effluvia* may, inſtead of promoting, hinder the Production of ſome particular Diſeaſe, whether Epidemical or Endemical in the Bodies of them that inhabit thoſe Places. For as Phyſicians obſerve that the more manifeſt morbifick cauſes of ſome ſickneſſes, are quite contrary to thoſe of others, ſo I think it not improbable, that there may alſo be a mutual contrariety, between thoſe latent morbifick cauſes, that are ſent up by ſubterraneal Agents. And therefore it need to be no wonder, if ſome of theſe ſhould either diſable thoſe to which they are Hoſtile, or ſhould at leaſt work in Humane Bodies a great Indiſpoſition to admit their hurtfull

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Operations, which methinks those Physicians and Chymists should easily grant, who with a boldness that I do not applaud, prescribe Amulets, wherein Arsenick, or some other poysonous Drug is employ'd, as preservatives from the Plague, against which, I doubt the chief Succours they afford, proceeds from the Confidence or Fearlesness they give those that wear them. But to return to our subterraneal *Effluvia*, since there are divers whole Countries, or lesser places, that are either altogether, or in great part, free from this or that particular Disease; as in several parts of *Scotland* from Agues, especially if I mistake not Quartans, are very unfrequent, insomuch that a learned Physician answer'd me, that in divers years practice he met not with above three or four, and in several large Regions of the *East-Indies*, notwithstanding the excessive heat of the Climate, the Plague is very rare: since (I say) these things are so, it seems not altogether improbable that the subter-

terraneal ſteams may contribute to this advantage, by impregnating both the Air, the Earth, and the Water, with Corpuſcles endow'd with Qualities unfriendly to theſe Diſeaſes, which ſeems to be ſomewhat the more credible, becauſe it has been obſerv'd that ſome vaſt Tracts of Land will neither breed nor maintain venemous Creatures, as is undoubtedly believ'd of the whole Kingdom of *Ireland*, where I confeſs I neither did ſee any alive, nor met with any other that did; for as to Spiders, though they breed in that Countrey, where I have ſeen many of them, and ſometimes even upon *Iriſh* Wood, yet they are unanimouſly believ'd not to be poyſonous there: And ſome Writers tell us, how truly I know not, of ſome other Countries, to which they affirm the like Privilege to belong. But there is one inſtance afforded us by *Begninus*, who travel'd much to viſit Mines, which if it be ſtrictly true, is very notable for my preſent purpoſe. *Dignum admiratione eſt*, ſays he, *quod quamvis in vicinia Hydriæ Comi-*

Comitatus Gloricienſis, ubi reperitur copioſè & ſingulis ferè annis Lues peſtifera graſſatur, illa tamen ſemper immunis ab hac manere ſoleat, idque viri provectæ ætatis ſe obſervaſſe & à majoribus ſuis accepiſſe, mihi ſanctè confirmârunt. To which I ſhould add the Teſtimony of the Learned *Michael Mayerus*, who pronounces Mercury to be an *Alexipharmacum* againſt divers Diſeaſes, and particularly the Plague, if I did not ſuſpect by his way of mentioning this laſt Diſeaſe, that he but borrowed his *Encomium* of Mercury from *Begninus*. But however; what has been related, has invited me to conſider, whether there may not be ſome virtue, as well as ſome danger, in Amulets of Quickſilver that are by many extoll'd againſt the Plague. But this onely upon the bye.

PROPOSITION III.

It is Likely, that divers Epidemical Diſeaſes are in great part produc'd by Subterraneal Effluvia.

I Am very well aware, that divers Diſeaſes that extraordinarily invade great numbers of people at the ſame time, (and were therefore, by the Greeks called *Epidemical*) may be rationally refer'd to *manifeſt Intemperateneſſes* of the *Air*, in point of Heat, Cold, Moiſture, or ſome other *Obvious Quality*. And therefore the *Propoſition* ſpeaks but of *ſome Epidemical Diſeaſes*, and imputes thoſe it ſpeaks of to *Subterraneal Effluvia*, not as *total*, but as *partial*, and ſometimes as *principal*, *Agents* in the production of them.

In favour of the propos'd Conjecture thus explain'd, I ſhall offer two things to Conſideration.

I. And first, it seems not very improbable, that divers of those *Morbifick Excesses* (especially if they be *sudden*) that are observ'd in the *Air*, may proceed from the unusually copious ascent of hurtfull *Exhalations* that mingle with the Air, and diffuse themselves through it. We are greater Strangers than we commonly take notice of, to the *Subterraneal* part of the Globe we inhabit: and if I had leisure, and thought it necessary, I could shew, that there are a great many odd and surprizing things to be met with in the Structure and disposition even of those parts of the Earth, that lie but a little way beneath the surface of it, and partly have been, and partly may easily enough be, actually penetrated by the industrious Labours of men. And as for the deeper Subterraneal Regions, we are so much more unacquainted with them, that we are scarce fit so much as to *conjecture*, how far they extend, or what

what kind of Materials they contain, and what is the groſs, and (if I may ſo ſpeak) the Mechanical Fabrick of the greater Maſſes, whether ſolid or fluid, they conſiſt of: And leaſt of all can we determine what Motions, whether periodical, or others, theſe Maſſes, or other Portions of deeply lodg'd Matter, may have.

On ſuch grounds as theſe, I conceive it poſſible, that, among the many and various Effluviating Bodies, that the terreſtrial Globe may conceal in its Bowels, there may be ſome, whoſe reeks aſcending plentifully into the Air, may occaſion in it an exceſs of Heat, Cold, Moiſture, thickneſs, or ſome other manifeſt Quality. So that ſometimes (not to ſay many times) even thoſe manifeſt Intemperateneſſes of the Air, to which an Epidemical Diſeaſe is wont to be wholly imputed, (though perhaps not very juſtly) may in part proceed from Subterraneal Bodies; for I elſewhere ſhew, that theſe by their Conflicts, or Mutual Actions on

one another, may excite great and ſudden Heats, and on that account ſend up ſuch copious Steams into the Atmoſphere, as may produce there ſudden and exceſſive Heats, Lightnings, Thunders, *&c.* And I ſhall now add (what perhaps will appear ſomewhat ſtrange) that I think ſudden and unſeaſonable Refrigerations of the Air, may proceed from the action of Subterraneal Bodies upon one another: for Tryal purpoſely made has inform'd me, that there are certain Minerals, whereof ſome may be employed in their crude Simplicity, and the other requires but a ſlight Preparation, ſuch as it may have in the Bowels of the Earth; which Minerals being put together, will produce by their Reaction an intenſe degree of Cold, not onely as to ſenſe, but when examined by a ſeal'd Weather-glaſs.

The Changes of the Air that produce *Epidemical Diſeaſes* are ſometimes ſo great and ſudden, that they cannot, in my Opinion, with pro-

probability be imputed to the action of the *Sun*, or the *Moon*, (which are cauſes that act in too general, and too uniform a way, to have thoſe *particular* and *anomalous* Effects attributed to Them;) as probably as they may be to *Subterraneal* Bodies, that often act with more ſuddenneſs and impetuoſity, and without any regularity, at leaſt that is known to us. The difference we find in Seaſons, that bear the ſame name, and ſhould be alike in temperature, is oftentimes very great, and ſometimes alſo very laſting. It is proverbially ſaid in *England*, that a *Peck of March Duſt is worth a King's Ranſom*: So unfrequent is dry Weather during that Month, in our Climate. And yet in ſome years, and particularly the laſt, 'twas a rare thing to have a ſhower either in *March*, *April*, or *May*, ſometimes in the Month laſt named, there are Heats greater than in the Dog-days of that ſame Year; though uſually here in *England*, divers Mornings of that Month are

cold, and ſome of them frosty. And now and then I have obſerv'd in the ſame Months and Days, at no great diſtance from one another, that the Weather has been ſultry hot, and has alſo produc'd a great Snow. We have ſeen Summers like that which is remember'd for the Siege of *Colcheſter*, that for almoſt the whole Seaſon, were more dark and rainy, than ſeveral Winters have been obſerv'd to be. To which purpoſe I remember, that when I was about to write the Hiſtory of Cold, I was fain to watch almoſt a whole Winter to find two or three frosty days, to make an Experiment or two I had need of, that requir'd not a Cold that was either laſting or very intenſe. But Inſtances of this kind are ſo obvious, to thoſe that are at all heedfull Obſervers, that I may ſafely paſs them by, and inculcate that the Sun being in the ſame Signs, at the ſame Times of the Year, it does not appear, how He ſhould produce ſo great a diſparity

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of the temperature of the Air in Seaſons of the ſame denomination; (as the Winters or the Summers of differing, and yet perhaps immediately conſecutive, Years.) And therefore I do not ſo much wonder, that many Learned Writers fly to Aſtrology for an account of theſe irregular *Phænomena*, and aſcribe them to the influences of certain Stars; notwithſtanding what divers eminent Philoſophers, and ſome great Aſtronomers too, have ſaid to prove the vanity of Judiciary Aſtrology.

I ſhall not now ſtay to diſcuſs the Queſtion, *whether the Stars have any influence diſtinct from their Light and Heat:* becauſe, my Opinion about it being ſomewhat peculiar, I have diſcourſed of it in a Paper by it ſelf. But this I ſhall now ſay, that the fixt Stars being but general, and (if I may ſo ſpeak) indefinite Agents, almoſt unimaginably remote from us, 'tis nothing near *ſo* likely that ſuch Effects as (beſides that they happen very ſuddenly and irregularly)

ly) are oftentimes confin'd to a Town, or ſome other narrow Compaſs, ſhould be produc'd by certain Stars: *as* that they ſhould be ſo by Subterraneal Bodies, which are near at hand, of very various natures, and ſubject to many irregular and differing Motions, commixtures, reactions, and other alterations. I have known a great Cold in a day or two invade Multitudes in the ſame City, with *violent*, and as to many Perſons *fatal* Symptomes; when I could not judge, (as others alſo did not) that the bare coldneſs of the Air could ſo ſuddenly produce a Diſeaſe ſo Epidemical and hurtfull: and it appear'd the more probable, that the cauſe came from under ground, by reaſon that it began with a very troubleſome Fog.

That there may be many Subterraneal Bodies, which by their commixtures may produce a ſudden Heat, will be eaſily granted by thoſe that know, (what I elſewhere purpoſely make out) that there are Subterraneal

neal *Menſtruums*; and are acquainted with Chymical Operations, ſuch as the great effervescence made, when Oil of Vitriol is put upon filings of Iron, or Spirit of Niter upon Butter of Antimony; to which I might add many other of the like kind that I have tryed, as when Spirit of Niter is put upon filings, either of Iron, Copper, or Tin, or upon crude Quickſilver; which I ſhall content my ſelf to have nam'd, becauſe I have another Inſtance that comes cloſer to our preſent purpoſe. For whereas I have ſhewn above, that there is in many places great ſtore of Marcaſitical matter beneath the ſurface of the Earth, and ſometimes very near it; I ſhall now add that I have purpoſely tryed, that putting a little Spirit drawn from Niter, (with which Salt the Earth in many places abounds) or a litle Oil of Vitriol, upon powder'd Marcaſites (which being hard Stones are more difficultly wrought upon, than many other Subterraneous marcaſitical Bodies

dies of a looſer texture) there preſently enſued a ſtrong reaction between the Liquid and the Solid Bodies, whereby was produc'd much heat, not without viſible fumes, and Strongly Scented, though not viſible, Exhalations. And ſuch kind of Odorous *Effluvia* were emitted, upon the putting a little Spirit of Salt upon our Powder'd Marcaſites. And becauſe Sulphur is a mineral that (either pure, or copiouſly mix'd with others) is to be plentifully met with in the Bowels of the Earth, and in many places burns there, I ſhall add, that I have found acid Spirit of Sulphur (made the common way) to work ſenſibly upon marcaſitical matter, hard enough coagulated. An experienc'd German Chymiſt relates, that in ſome parts of his Country he met with Vitriol Stones, or Marcaſites, that, by the action of mere common Water reſting a competent time upon them, will grow ſo hot as to enable the Liquor to retain a

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ſenſible Heat, when it had paſs'd a pretty way from them. And, as I elſewhere ſhew, that many Accidents may occaſion the breaking out of Waters, or the change of their courſe in Subterraneal Places; So, that common Water may produce in a very ſhort time conſiderable degrees of Heat in Mineral Bodies, may appear by mixing with two or three pounds of fine Powder of common Brimſtone a convenient quantity, (for now I remember not well how much I took) of filings of Iron, for this mixture being thoroughly drench'd with common Water, did in a ſhort time grow intenſely hot, and ſend up ſuch a thick Smoke as good quicklime is wont to doe, whilſt men Slake it with Water.

It is obſervable to our preſent purpoſe, what account was given me by a Domeſtick of mine, that liv'd in the North part of England, of a certain Mineral Groove which he had often occaſion to reſort to: for, when

when I ask'd whether the Damp that place was molested with, did frequently recurr; he answer'd me, that at the time he was there it would annoy the workmen, (if they did not take good care of themselves) more than once in one day. And by Enquiries that I made of others that were conversant in Mines, I learn'd, that in divers places they were molested with Damps, that came not at stated Periods, but irregularly; sometimes with much greater, and sometimes with far lesser, Intervals between them: the times of their duration being also not seldom unequal. So that, supposing such noxious *Effluvia* to be plentifully emitted from the lower parts of the Soil, it need be no wonder, that an *Epidemical* Disease should be rife in this or that particular Town or part of a Country, without spreading much farther; and that it should begin suddenly in places where it was not expected: for, besides that these swarms of *Effluvia*, being

being produc'd by casual concourses of Circumstances, may oftentimes be excited, and invade this or that place, without giving the Inhabitants any warning, besides this, I say, 'tis not always necessary that these noxious *Effluvia* should be generated just under the places they molest, since the motion of the Air, especially when the Wind sits favourably, may suffice to carry them to the Town or other place that feels their ill effects: and yet they may seem to be almost confin'd to those places; sometimes because the neighbouring places are not inhabited enough to make their ill qualities taken notice of; but more frequently because, by being diffus'd thorough a greater tract of Air, they are more and more disperst in their passage, and thereby so diluted (if I may so speak) and weakn'd, as not to be able to doe any notorious mischief.

And here I Consider too, that 'tis not always necessary that the harm that is done by these morbid Con-

Conſtitutions of the Air, ſhould proceed onely or preciſely from theſe Subterraneal Exhalations we are ſpeaking of, by virtue onely of their own qualities, which they bring with them from under ground. For 'tis very poſſible, that theſe *Effluvia* may be in their own nature either innocent enough, or at leaſt not conſiderably hurtfull, and yet may become very noxious, if they chance to find the Air already imbu'd with certain Corpuſcles fit to aſſociate with them: for, though theſe ſorts of Particles were perhaps neither of them a-part conſiderably hurtfull, yet there may from their Combinations reſult Corpuſcles, of a new and very morbifick nature.

This may be ſomewhat illuſtrated by conſidering, that the ſpirituous ſteams of Salt-peter are not wont ſenſibly to work on Gold, nor yet the ſpirituous Parts that the Fire raiſes from *Sal-armoniac*; and yet when theſe two ſorts of Particles convene, there reſults from their Coalitions certain

certain Corpuſcles of a new nature, that compoſe the Liquor Chymiſts call *Aqua Regis*; which by its fretting quality corrodes and diſſolves Gold. By Analogy to this we may conceive, that ſometimes the Subterraneal *Effluvia* may find the Air already impregnated with ſuch Corpuſcles, that by aſſociating themſelves therewith they may compoſe Corpuſcles far more capable, than themſelves were whilſt apart, of having ill Effects upon the Maſs of Bloud, or ſome determinate Parts of Humane Bodies, and conſequently of produceing Diſeaſes there.

And this Inſtance may appear the more appoſite; becauſe it may be ſaid, that *as*, though Silver and Gold, and Diamonds and Rubies, *&c.* be put together, and *Aqua Regis* be pour'd upon them, it will leave all the reſt uncorroded, and fall onely upon the Gold; *ſo* the newly produc'd Corpuſcles that I have been ſpeaking of, whether breathed in with the Air in Reſpiration,

or carried up and down by the Bloud, or other Liquors of the Body, may pass by other parts of it without doing them any sensible harm, and attacking this or that determinate part, produce there some Disease such as the fabrick and situation of that part peculiarly dispose it to be affected with.

And I shall add on this occasion, that in our *Hypothesis* we may render a probable reason, why in some Epidemical Diseases, some persons may escape much better than other, that seem likely to be, at best, as obnoxious to them, without a recourse to the peculiar Constitutions of the Bodies of differing Persons; for it may be conjectur'd, that the noxious Corpuscles that infest the Air, may (especially in windy weather) be very unequally disperc'd through the Air, and many fly in far greater or lesser numbers within equal spaces of Air; and consequently the Persons, that have the ill luck to be in the way of the more

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numerous ſwarms of morbifick Corpuſcles, may be much more prejudiced by them than others, though of weaker conſtitutions, who happen to be attaqu'd but by few of them.

On which occaſion, I remember, that a great many Trees in ſome Land that belongs to me, having been ſuddenly much endamag'd by a wind, that was not able to doe it by it's bare ſtrength; I had the curioſity to view ſomewhat heedfully a Tree that ſtood in the Garden, and perceiv'd that all the conſiderable miſchief was done to that ſide of the Tree, which reſpected the corner whence the hurtfull Wind blew, the Leaves of the other ſide continuing freſh and verdant, as being by the other part of the ſame Tree fenc'd from the Wind: and it was farther obſerv'd, that even the expos'd ſide of the Tree was not every-where endamag'd; for there were divers parts, where the Leaves continued ſound and green, though neighbouring Leaves were ſome more, ſome

leſs (for all that were prejudic'd were not totally) blaſted: the ſound Leaves and the diſcolour'd being ſo odly mingled, that I conjectur'd the cauſe of the miſchief to have been this; that ſome Arſenical or other corroſive or poiſonous Exhalations, being ſuddenly emitted from the Subterraneal parts into the Air, were by the Wind they chance to meet with there, hurry'd along with it, and blown againſt the Bodies that ſtood in it's way, moving in the Air, like Hail-ſhot diſcharg'd out of a Gun, here in a cloſer, and there in a more ſcattering order, ſo that as more or fewer of them happend to fall upon the ſame Branch or Leafe, they left more, or leſs marks of their paſſage, by deſtroying the texture and colour in the Leaves or parts of them they chanc'd to beat upon. And this may poſſibly be the cauſe of ſome of thoſe ſudden and ſometimes fatal Effects, that I have known in ſome places the people talk much of, complaining, that ſuch a one had his

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Eyes, or his Face, or onely one ſide of it blaſted, by a malignant Wind, of which I thought I ſaw an Example in a Domeſtick of my own, whilſt in ſuch a Wind he was riding after me, who (thanks be to God) had no ſuch miſchief done me.

But the Vulgar have entertain'd ſuch ſtrange Conceits and Stories about theſe Blaſtings, on which account ſome of them ſay that Men are *Planet-ſtruck*, that the fabulous things mingled with thoſe that are poſſible, have made intelligent Perſons reject them all.

One thing more I ſhall take notice of in favour of our *Hypotheſis*, which is, that it well agrees with what has been obſerved, not without ſome wonder, of the very ſhort duration of ſome Epidemical Diſeaſes, in certain Times and Places. For this may proceed from hence, either that all the Morbifick Expirations aſcended into the Air almoſt at once, or at leaſt within a ſhort time, and ſo were eaſily ſpent, that is by diffuſion or

diſperſion ſo weakned, as to be diſabled from doing much miſchief: or elſe the Subterraneal Commotion that produc'd them may paſs on from one place to another, and ſo ceaſe to afford the Air incumbent on the firſt place, the ſupplies neceſſary to keep it impregnated with noxious Exhalations. And it agrees well with this Conjecture, that ſometimes we may obſerve certain Epidemical Diſeaſes to have as it were a progreſſive Motion, and leaving one Town free paſs on to another. Of which ſome Obſervations that I have made, encline me to think, that if Phyſicians would heedfully mind it, they might take notice of ſeveral Inſtances.

One thing more may be added, as conſonant to our *Hypotheſis*; namely, that ſometimes an Epidemical Diſeaſe ceaſes in this or that place, almoſt as ſudden as it invaded, or at leaſt in a much ſhorter time than Phyſicians expected. For according to our *Hypotheſis* it may well happen, that

that after one ſort of Exhalations, whoſe peculiar Qualities make them Morbifick, have deprav'd the Air incumbent on a particular place; there may by a new or farther Commotion of Subterraneal Bodies, be ſent up into the Air ſtore of Expirations of another kind, which meeting with thoſe that formerly impregnated it, may either precipitate them, and ſo free the Air from them; or by other operations on them, and ſometimes even by Coalitions with them, ſo alter their nature as to diſable them from doing any farther miſchief.

This I ſhall illuſtrate, if not confirm, by that very remarkable *Phænomenon* that is yearly obſerv'd at *Grand Cairo* in *Ægypt*; for, (though I know not whether or no the Corpuſcles that produce it ariſe from under Ground, the affirmative part of the Queſtion being not improbable) it appears, that by the intermixture of adventitious Corpuſcles, with the formerly Peſtilential Air, 'tis ſo alter'd and cor-

corrected, that within one day or two, if not within a leſſer compaſs of time, there is a ſtop put to the progreſs of the Plagues; that in that favourable time of year, namely about the middle of Summer, ſcarce ever miſſes of raging in that populous City: and, which is more admirable, theſe ſanative Corpuſcles (if I may ſo call them) operate ſo powerfully, that of thoſe that are already ſeiz'd by that fatalleſt of Diſeaſes, the *Plague*, few or none die of it, after once theſe Antidotal Particles have ſufficiently impregnated the Air. I confeſs ſo great and ſudden a change is very wonderfull, and I ſhould ſcarce think it credible, if I had not had the means and curioſity to enquire about it of divers perſons, ſome of them very intelligent, that either curiouſly viſited, or alſo made ſome conſiderable ſtay in, that great City; and found them agree in the main about the truth of the matter of fact; which is much confirm'd to me by ſo eminent a Teſtimony as that of the learned

learned *Prosper Alpinus*, who for several years practis'd Physick in *Grand Cairo*, and as an Eye-witness delivers what he relates more authentically, as well as more particularly, than any I have met with. And, though he endeavours to give several reasons of this strange and sudden cessation of the malignity of the Plague, yet I doubt they are not sufficient for so wonderfull an effect; unless we take in some new Exhalations, that then impregnate and correct the Air.

And we shall scarce doubt of the great interest these have in the effect produc'd, if we give credit to what the recenteſt Writer I have met with of Voyages into *Egypt*, has lately publish'd about the annual Pestilence at *Grand Cairo*, a City he much frequented. This Authour, in the account he gives of the present state of *Egypt*, relates that a little after the middle of our *June* (and usually upon the very seventeenth day) there begin to fall towards the last quarter of the night, near

near the morning, certain drops of a kind of Dew, which causes the River to be fruitfull, and purifies the Air from all the Infection of *Camsims*, by which I presume he means the *Pestilence*: for after some lines interpos'd he subjoins, *The Drops or Dew purifies the Air, for as soon as it falls the Plague ceases to be mortal, none dies of it; the Air is wholesome, all Distempers cease, and if any person grows sick, he never dies.*

And then, he adds, *This Dew gives life to every thing; and when it falls upon the Wheat, it causeth it to continue many years without corruption or Worms, and is far more nourishing than that Corn on which it never falls. For this cause they never house the Corn of the Grand Seignior in the Barns, till this Dew is fallen upon it, that it might keep the longer without Worms.*

As well this Conjecture, as some other things deliver'd here and there in this Paper (about the *Salubrity of the Air,*) may probably gain the more

more credit, if I here ſubjoin what I learn'd by inquiry from a very ingenious Gentleman, who was owner of one or more of the Mines, that afford the *Phænomenon* I am to mention. Which is this, That in the Tin-mine Countreys in *Devonſhire*, it ſometimes happens, (as perhaps I may have elſewhere noted to another purpoſe,) that upon a ſudden, a Spot of ground, and that not always narrow, will be as 'twere blaſted by the aſcending hurtfull Fumes; inſomuch that not onely the Graſs, Fern and other more tender Vegetables, will be turned black, and as it were burnt or ſcorched up; but now and then Trees alſo, without excepting Oaks themſelves will be blaſted and ſpoil'd by the powerfull Operation of theſe ſubtil and poiſonous *Effluvia*.

It will probably be here expected, that among the Epidemical Diſeaſes that our *Hypotheſis* derives from Subterraneal *Effluvia*, I ſhould particularly treat of the cauſe of *Peſtilential*

lential Fevers, and the *Plague* it self. But, though some such *Fevers* may not improbably be in great part imputed to the noxious Expirations of the Globe we inhabit; yet, as to the true *Plague* it self, I freely confess I am at a loss about it's Origine.

The sacred Writings expresly teach, that some Plagues, and particularly that which in *David*'s time swept away in three days 70000 Persons, have been in an extraordinary manner inflicted by God. And to me it appears either scarce possible, or far more difficult than those that have not attentively enough considered the matter, are wont to think it; To deduce the abstruce Origine, strange Symtomes, and other odd *Phænomena* of some Plagues that are recorded in History, from merely Corporeal Causes.

On the other side, it seems unphilosophical, and perhaps rather seems than is very pious, to recur without an absolute necessity to Supernatural

tural Cauſes, for ſuch Effects as do not manifeſtly exceed the power of Natural ones: though the particular manner of their being produc'd, is perchance more than we are yet able clearly to explicate. And I think it the more queſtionable, whether all Plagues are Supernatural Exertions of God's Power and Wrath againſt the Wicked, becauſe I obſerve that *Brutes* (which are as well uncapable of moral Vice, as moral Vertue) are yet oftentimes ſubject to *Murrains*, ſuch as may without incongruity be lookt upon as the *Peſtilences of Beaſts*. And 'tis the leſs likely, that theſe ſweeping and contagious Maladies ſhould be always ſent for the puniſhment of impious men, becauſe I remember to have read in good Authours, that, as ſome Plagues deſtroy'd both Men and Beaſts, ſo ſome other did peculiarly deſtroy Brute Animals, of very little conſideration or uſe to Men, as Cats, *&c.*

Upon these and the like Reasons I have sometimes suspected, that in the Controversie about the Origine of the Plague, namely, Whether, it be Natural, or Supernatural; neither of the contending Parties is altogether in the right: since 'tis very possible, that some Pestilences may not break forth, without an extraordinary, though perhaps not Immediate, interposition of Almighty God, provok'd by the Sins of Men: and yet other Plagues may be produc'd by a Tragical concourse of merely Natural Causes.

But *though* the difficulties that incumber each of the opposite Opinions, keep me both from Dogmatically asserting, that All Plagues have a Supernatural Origine; and from denying that Any have it: *yet*, to say something on such an occasion, though I can speak but very hesitantly, I shall venture to add, that, whether or no the true Plague be said to descend to the Earth from a higher Sphere than that

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of Nature; yet its Propagation and Effects are (at leaſt for the moſt part) carry'd on mainly by a malignant diſpoſition in the Air; without which ſome Plagues could never have been ſo catching as they were, nor ſo ſuddenly mortal; and that in divers Peſtilences this malignant Diſpoſition in the Air, may probably be in great part imputed to ſome kinds of Subterraneal Expirations, I am prone to think; and that chiefly upon two Accounts.

The *firſt* thing that induces me to this Conjecture, is, that not any of the ſeveral Cauſes to which the Plague is wont to be imputed ſeems to me to be ſufficient. Thoſe that fetch it from the malevolent aſpects and influence of the Celeſtial lights, beſides that they ſuppoſe ſome things very difficult to be prov'd, have recourſe to Agents too remote, too general, and too indeterminate, to be acquieſc'd in as the Cauſes of ſuch particular Symtomes and *Phænomena*, as oftentimes accompany Peſtilences.

And as for those other Sects of Physicians that confidently derive the Plague, some from Internal Putrefaction, and others from excessive Heats, noisome Stinks, Corrupt aliments, and such other Celebrated Causes; though each party alledges plausible Reasons for its own opinion, yet their objections against their adversaries are much stronger than their arguments are for themselves. And the Learned *Diemer-broeck*, though his own Hypothesis seem to be more Theological than Philosophical, has much enervated the Arguments brought for the several opinions lately nam'd, and by him dissented from.

The Reasons he employs to refute all the receiv'd opinions about the Origine of the Plague, except his own, are divers of them worthy of so learned a man; to whom, though I had leisure to transcribe them, I should refer the Curious: my present design being onely to deliver some few things that seem more favou-

vourable to my Conjectures, than to his Opinion, and were ſuggeſted to me, partly by my own Thoughts, and partly by the informations, that, to examine thoſe Thoughts, I procur'd by conſulting ſome uncommon Authours, and asking Queſtions of great Travellers and Navigatours. By this means I came to learn, that divers great Countries are uſually free from the Plague, that according to the vulgar *Hypotheſes*, ought to be as much ſubject to it, if not more, than *England*, *France*, *Italy*, and thoſe other parts of *Europe* and *Aſia*, where that fatal Diſeaſe rages from time to time in the parched Regions of *Africk*, to which the Exceſſive Heats would make one expect, that the Plagues ſhould make far more frequent viſits than to our temperate European Countries; *Leo Africanus* informs us, that ſome parts are ſo ſeldom afflicted with that dreadfull Diſeaſe, that it uſually ſpares the Inhabitants 29, or 30 years together. And he expreſly records, that *in Numidia*

midia it ſelf, (if I much miſremember not the Countrey's name, notwithſtanding the raging heat of the Climate, *the Plague is wont to be produc'd but once in a hundred years.*

Our * *Purchas* informs us that *in the Land* of *Negro's* it is not known at all. And to omit what ſome Travellers and Navigatours relate of *Japan*, as if it were ſeldom or never invaded by the Peſtilence; I do not remember that in New *England*, which contains a great extent of Land, though I have had both Curioſity and opportunity to inquire after the Diſeaſes of that Countrey, I ever heard the Engliſh take any notice of the Plague, ſince their ſetling there above threeſcore and ten years ago. And as for the Eaſt *Indies*, Sir *Philibert Vernatti*, a *Virtuoſo* of great fame and authority at *Batavia* where he reſides, in his ingenious Returns to the Queries ſent him by the *Royal Society* (*of Naturaliſts*) anſwers thus to the fifteenth,

* Purchas's *Pilgrimage, lib. 6. cap.* 13.

teenth. [*Peſtis morbus eſt Indiarum Incolis incognitus*] *The Plague is a Diſeaſe unknown amongſt the Indians.* And of the Countries that lie yet more remote, as the great Empire of *China*, and the Kingdoms of *Tunquin*, and of *Cochinchina*, that great Traveller *Alexander de Rhodes*, who ſpent 30 years in thoſe parts, affirms, that the Plague is not ſo much as ſpoken of there. And yet the ſame Jeſuit does, upon grounds probable enough, eſtimate the number of the people of *China* alone to be two hundred and fifty millions; [a number I take to exceed by far that of all the Nations of *Europe*.] Now when I conſider, how vaſt Tracts of Land are compriz'd in thoſe Countries, ſome of which the Plague does not at all, and others but exceeding unfrequently, invade; this Immunity ſeems to me very unfavourable to moſt, if not all, the opinions receiv'd among Phyſicians, as alſo that of *Diemerbroeck* himſelf who derives the Plague from a *Supernatural Cauſe*,

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the wrath of God againſt the ſins of men. For in Regions of ſuch extent, and divers of them very populous, which are ſeated under very differing Climats, and which are ſome of them inhabited by Nations, that make war with numerous Armies, fight bloudy battels, leave heaps of unbury'd Bodies expos'd to the putrefying heat of the Sun; are ſometimes fore'd, as well as others to live upon very unwonted and unwholſome foods; that worſhip ſtocks and ſtones, and beaſts, and ſome of them Devils, whom they know to be ſuch; that are at leaſt as guilty as Europeans, of Aſſaſſinats, Poiſonings, Rapes, Oppreſſion, Sodomy, and other crying Sins: in theſe Regions, I ſay, 'tis not imaginable but that great Intemperatures of the Air, eſpecially, in point of Heat, Stench of dead Bodies kill'd in fights, unwholſomneſs of Aliments, malevolent aſpects of Celeſtial Bodies, high provocations of the divine Juſtice, and in ſhort, all the Cauſes, to one or other of which the ſeveral

ral parties of Phyſicians are wont to refer the Plague, ſhould be wanting any more than in our *Europe*; and yet the Plague which is preſum'd to be the Effect of one or other of thoſe Cauſes, is not here obſerved to be produc'd.

I know that it may be ſaid, that the Hiſtorical things I have been reciting, do not onely oppugn the ſeveral receiv'd Opinions of Phyſicians about the cauſe of the Plague, but diſfavour my Conjectures too. But if this be ſaid, I deſire it may alſo be conſider'd, that my Judgment about the Plague conſiſts of two Parts; *One*, that 'tis exceeding difficult to aſſign the true and adequate Cauſe of the Origine of the Peſtilence; and the *Other*, that whatever be the Cauſe of its Firſt Eruption, its Propagation and divers of its Symptomes, may be probably enough refer'd to the depravation of the Air by Subterraneal Steams, and their Effects. If this be duly conſider'd the Hiſtorical Obſervations will

will appear not to overthrow the *First* member of our Hypotheſis, but rather to confirm it: and 'tis upon this account that I have mention'd them in this place. And as to the *Second* member it may be ſaid, that ſince in the Eaſt *Indies* and the other Countries, I have nam'd, as privileg'd from this raging Diſeaſe, it is not obſerv'd to break out: as it cannot be ſaid that Subterraneal *Effluvia* do in thoſe Countries promote the Propagation of it; ſo it cannot be prov'd that they could not doe it, incaſe the Plague were begun by other Cauſes. But in regard I think it not improbable that ſometimes the Plague is not onely fomented but begun by noxious Expirations of the Terreſtrial Globe, I ſhall add that this ſuppoſition, though I confeſs it be ſomewhat disfavour'd by ſome of the lately mention'd Obſervations, yet is not abſolutely inconſiſtent with them. For Firſt, it may be ſaid that ſome of the Countries I ſpeak of, may be deſtitute of

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thoſe noxious minerals to which we impute ſome Plagues, it holding true in Minerals as well as in Plants. *Non omnis fert omnia tellus*, and to omit what I have not without ſome wonders obſerv'd, of the Limits of differing ſorts of Mines and Mineral Veins in very bordering parts of the ſame tract of Land, I cannot but here take notice, that though Sulphur be in many Countries uſually found, and that in plenty where there are other Metalline Veins, inſomuch that Chymiſts make it one of the three Principles of all Metals, yet in the Mines of *England* more ſtrictly ſo call'd, I do not remember I ever met with ſo much as an Ounce of Native Sulphur, and I could not find by divers Mineraliſts, of whom I purpoſely ask'd the queſtion that they had met with any among the various Mines they had frequented. It may alſo happen that there may be hurtfull Minerals in a Countrey, and yet not capable of often producing or promoting Peſtilences there,

there, even upon moderate Earthquakes. For 'tis poſſible that theſe Orpimental or other Noxious Minerals may have their Beds or Veins lying ſo deep in the Earth, that they are not ordinarily able to ſend up *Effluvia*, ſtrong and copious enough to make a Peſtilential depravation of the Air, and even in leſſer Earthquakes the commotion or agitation of the ground, eſpecially if the Earth-quakes proceed (as one may ſuſpect that divers of them do) from the ſudden fall of ponderous Maſſes in the hollow parts of the Earth and the ſhakings of the ground thereby produc'd, and ſometimes ſpreading far, may not reach ſo far downwards as much to affect theſe very deep Mines, and yet ſome other more violent Earthquakes, may affect even theſe; upon which ground one may give ſome tolerable account why the Plague in ſome parts of *Africk* has been obſerv'd to rage but once in thirty or once in an hundred years; for there may be periodical

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Paroxyſms, if I may ſo call them, or grand and vehement Commotions in Subterraneal Parts, though men have not yet, for want of ſufficient Longevity or Curioſity obſerv'd them. On which occaſion, I remember that a late judicious French Hiſtorian recounts that in part of the laſt age, and part of this, a very pernicious Diſeaſe of the nature of a Colick raign'd in *France* every tenth year for a long tract of time. And the Experienc'd * *Platerus* relates, that at *Baſil*, where with great ſucceſs he practis'd Phyſick fifty ſix years, the City was afflicted with furious Plagues once about every tenth year for ſeventy years together, of each of which Peſtilences he gives a particular account in his uſefull obſervation. It may alſo farther be ſaid, that thoſe Exhalations in the Eaſt *Indies*, *&c.* that would otherwiſe be peſtiferous, may be corrected by other Expirations that may be either of benign nature, or of ſuch a nature

* *Lib.* 2. *P. M.* 323.

ture, as though noxious in themſelves, may fit them by combining with thoſe that would be peſtiferous to diſable them to be ſo, as I elſewhere obſerv'd out of *Beguinus*, that a Countrey abounding in veins and maſſes of Cinnabar, which is the Ore of Quickſilver, was preſerv'd from the Plague, when the neighbouring Regions were waſted by it; and I ſhall illuſtrate this matter ſomewhat farther by taking notice, that though Corroſive Sublimate be ſo miſchievous a Mineral Compoſition, that a few grains may kill a man, yet the fumes of this combin'd with thoſe of *Crude*, common Quickſilver, which are themſelves unwholeſome enough, make *Mercurius dulcis*, which is a mixture ſo innocent, that being well prepar'd, and well adminiſtred, it is both ſafely and uſefully given even to Children.

If what has been ſaid will not ſuffice, I ſhall propoſe another poſſible way of accounting for the immunity of ſome Countries from the Plague.

Plague. For one may conceive that in ſuch Regions the Soil, and other aſſiſting Cauſes may conſtantly produce in the Air ſuch a Conſtitution as is found in the Air of *Egypt*, during the time of the increaſe, and overflowing of *Nile*, which uſually laſts every year for ſeveral weeks, for during this time the Air is ſo antipeſtilential, that not only the Plague does not make a new Eruption; but is either wonderfully check'd or quite ſuppreſs'd in thoſe houſes that it has already invaded, ſo that its mortal infection reaches no farther, and that it may not be thought incredible that ſome Countries may have, if I may ſo ſpeak, an antidotal Nature, in reference to ſome pernicious Evils, I ſhall repreſent that there are ſome whole Countries which are privileg'd from producing Vipers, Toads, and other venemous Creatures, as is vulgarly known concerning *Ireland*, where I could never ſee any ſuch, nor find by Enquiry of either the Natives, or Engliſh In-

habitants, that they had met with any in that Kingdom, where 'tis an uncontroll'd tradition, that if Poysonous Creatures have been carefully brought there from other Parts, they have died almoſt as ſoon as they came thither. There are ſome other Iſlands to which a like hoſtility to venemous Animals is aſcrib'd: and as it ſeems not inpoſſible that ſome Countries ſhould have a Soil that ſo impregnats the Air as to make it ſuppreſs or quite enervate many differing ſorts of Poyſons, ſo others may by their Conſtitution be qualify'd to maſter or reſiſt poiſonous Expirations or wandering Corpuſcles, that elſewhere are wont to produce the Plague. And this may ſuffice for the firſt thing whereon we ground our Hypotheſis.

The Second thing that invited me to the above propos'd Suſpicion or Conjecture, is, That it affords a not improbable account of ſome conſiderable things, relating to the Pro-

Production and *Phænomena* of the Plague.

(1.) As *First*, 'tis obſerv'd that ſometimes the Plague breaks out, when there has not preceded any ſuch immoderate diſtemper of the Air, or any caſual Enormity capable of producing ſo great and anomalous an Effect. Nay, which is more, it has been obſerv'd, that very great and unuſual intemperateneſſes of the Air have ſeveral times happen'd, and divers notable and threatning Aſpects of the Stars have been noted by good Writers without being follow'd by the Plague. The celebrated * *Fernelius* relates, that near the time he writ this Obſervation, that Year, which of all thoſe that had paſs'd in the memory of Man, was all the World over the moſt immoderately hot, and was yet moſt healthfull. And the ſame Authour reports the Plague to have begun in the midſt of Winter, and to have gone off in Summer, and that ſeve-

* *De abditis rerum cauſ. lib. 2. c. 13.*

ral times ardent Summers have been altogether free from the Plague: which I also have noted to be true. *Johannes Morellus* observes, that in his Countrey after a dry Winter, and wherein the North Wind reign'd, though it were succeeded by a most temperate and healthfull Spring, yet this brought in the Plague, and that, when the North Wind was predominant and the Air pure and sincere. Which I the less scruple to believe, because I observ'd something very like it in the Constitutions of the Air, that preceded and accompany'd the dreadfull *London* Plague that broke out in the year 1665. Which *Phænomena* much disfavour their Opinion that impute the Plague to the excesses of the manifest Qualities of the Air; but are agreeable to our *Hypothesis*, since by what has been formerly deliver'd, we may gather that Noxious Subterraneal Fumes may be suddenly, and without any warning belch'd up into the Air, and, by depraving it, produce fatal

fatal Diſeaſes in many of thoſe that are conſtantly ſurrounded by it, and draw it in, almoſt every moment, with their breath.

Of the deadly Hurtfulneſs of divers Subterraneal Expirations, at their firſt Eruption, there are many Hiſtories extant in approv'd Authours: And we have obſerv'd Inſtances of that ſort, in the Times and Countries we live in. But, becauſe all Poiſonous, and even mortal, Exhalations are not therefore truly Peſtiferous, but may, like many other Poiſons, kill the Perſons they immediately invade, without qualifying them to infect others; I ſhall add a Paſſage out of that Excellent Hiſtorian "*Monſieur de Mezeray* who "relates in the life of *Philip de Va-*"*lois*, that the Plague that happened "in *France* in the Year 1346. was "ſo contageous and deſtructive, that "ſcarce a Village, or even a Houſe, "eſcap'd uninfected by it. He adds, "that this Peſtilence, than which "none had been obſerv'd more furi-

" ous and ſpreading, began two years " before in the Kingdom of *Cathay*, by " a vapour that was moſt horribly ſtin- " king, which brake out of the Earth " like a kind of Subterraneal fire, con- " ſum'd and devour'd above 200 " Leagues of that Countrey, even " to the very Trees and Stones, and " infected the Air in a wonderfull " manner. *From Cathay*, ſay's he, " *it paſs'd into Aſia and Greece, thence* " *into Africk, afterwards into Europe,* " *which it ranſack'd throughout.* Other Inſtances, of Peſtilences begun by noxious Subterraneal Fumes, I have met with in good Authours; but cannot now recall the Particulars to mind, and therefore ſhall paſs on to the ſecond Obſervation.

See Diemerbroeck de Peſte, lib. 1. cap. 8.

(2.) In the next place then; whereas 'tis noted by diligent Obſervers, that there is a wonderfull diverſity in ſeveral Countries, and even in the ſame Countrey at ſeveral diſtant times, of thoſe raging Diſeaſes, that Phyſicians agree in calling the

the Plague, (whence it happens that ſuch Medicins or Methods of curing as are in one Plague ſucceſsfull, as Phlebotomy, Purging, *&c.* do oftentimes in another prove dangerous, if not mortal) whereas (I ſay) this great variety has been obſerv'd in Plagues; it may be fairly accounted for, by the great number and diverſity that has been actually found, or may be reaſonably ſuppoſ'd, in the numerous Minerals, and other Bodies that nature has lay'd up in the Subterraneal Regions: eſpecially if we conſider, that the number of ſuch Bodies may be much increas'd and diverſified, by the various combinations which may be made of them, not onely by caſualties, but by the action of Subterraneal Fires, and *æſtuaries*, and *menſtruums*, ſuch as I have elſewhere ſhewn to be lodg'd beneath the turf or *ſuperficies* of the Earth. And the aſcending Corpuſcles of thoſe Mineral Bodies, being moſt of them ſolid and ſubtile, may produce in the Bloud;

and ſo in the Body, far more odd, and violent Symtomes, than the peccant Humours that uſe to beget ordinary Diſeaſes. Which may be one reaſon, and perhaps the chief, why the ancient Heathens, and *Hippocrates* himſelf, acknowledg'd in Peſtilential Diſeaſes θεῖον τί, ſomewhat of Divine, ſurpaſſing ordinary Nature.

What theſe Mineral Subſtances are, whoſe ſteams produce ſuch odd and diſmal Symtomes, I think exceeding hard to determine. Yet, if I were to name *one* ſort, I ſhould perhaps think the leaſt unlikely to be Orpiment. For, of the Poyſonous Minerals we are acquainted with, I know not any of which there is greater quantity in the Bowels of the Earth; eſpecially taking that name, in the latitude allowed it, by thoſe skilfull men, that make three ſorts of it, *viz.* Yellow, Red and White Orpiment, divers of whoſe miſchievous Effects ſeem to agree well enough with the Symtomes of ſome Plagues,

and

and may be gueſſed to have at leaſt a conſiderable intereſt in the production of them. But yet, to ſpeak candidly, I do not think that theſe Minerals are the cauſes, even of all thoſe Peſtilences whoſe efficients may come from under the Ground: For ſeveral reaſons, and ſome drawn from Experience, make me think that the Subterraneal Regions have many kinds of very miſchievous foſſiles, of which Phyſicians, and even Chymiſts, have no knowledge, and for which they have not any diſtinct names; and that the various aſſociations of theſe, which Nature may by Fire and *menſtruums* make under Ground, and perhaps in the Air it ſelf; may very much increaſe the number, and variety of hurtfull Matters, and alſo heighten their hoſtility to Humane Bodies: as I think may be argued from the factitious White Arſenick that is commonly ſold in Shops, which though uſually made of Orpiment, by the addition of ſo innocent a Body as com-

common Salt, (which is found in great plenty under Ground,) is obſerv'd to be far more poyſonous than Orpiment it ſelf. And I remember that a skilfull Chymiſt, having in my preſence taſted ſome prepar'd, and, as was thought, ſomewhat corrected Arcenick; was quickly invaded by ſuch Symtomes, as he thought would preſently kill him. But, through God's bleſſing, I quickly put him out of danger, though not out of pain, by early preſcribing him ſtore of Oil of ſweet Almonds, and ſomething made of Lemmons, that I chanc'd to have by me: But to return to what I was ſaying; Sandarach ſeems to be, but Orpiment whoſe yellow Colour is deepn'd to Redneſs: and native Arſenick, (for I have ſeen ſuch a thing, though it rarely comes into *England*,) ſeems to be little other than pale or white Orpiment. And indeed in *Hungary*, all three may be found not far from one another in the ſame Mine; As I learn'd by Inquiry from an obſerving

ving Eye-witneſs, by whoſe means, and of another Chymiſt, divers Native Orpimental Minerals (to ſay nothing of Realgar) becauſe it is a Factitious combination of Orpiment and Sulphur, came to my hands. And as this ſort of Foſſiles comprizes more numerous and various ones, than is vulgarly noted, ſo the very noxious effects of the *Effluvia* of Orpiment, are not unknown to divers Phyſicians: and the Learned *Sennertus* gives a particular inſtance of it in a Painter, who upon opening a Box where Orpiment, which men of his Profeſſion uſe as a Pigment, had been long kept, had his face all ſwell'd, and was caſt into fainting Fits. And as White Arſenick is of a more piercing and corroſive nature, ſo it were not difficult to ſhew out of the Writings of eminent Phyſicians that *its effects have* divers times proved very hurtfull, and ſometimes mortal. When but externally worn in Amulets, eſpecially if the Pores

Senn. *M. P. E. vi. p. 66.*

of

of the Skin were open by exerciſe and ſweat; and the nature of the Symptomes produced ſeems to confirm our Hypotheſis, ſince the Perſons that wore theſe Arſenical Amulets were affected, ſome with great anxieties about the Heart, ſome with inflammation, ſome with burning Fevers, ſome with exulceration of the Breaſts, ſo ſome with Puſſles like thoſe of the Plague, and theſe were ſometimes black, as if made with a Cauſtick: moſt Patients were affected with great weakneſs and faintneſs, *&c.* as if they had ſwallowed Poiſon; and of one young Man 'tis recorded, that having heated himſelf in a Tenniſcourt with an Amulet upon his Breaſt, the virulence of its Corpuſcles made him fall down ſtark dead upon the Spot. And 'tis a conſiderable Circumſtance in theſe Obſervations, that ſeveral Patients were cur'd of the Symptomes that ſeem'd to be Peſtilential ones by the ſame Remedies that are Alexipharmacal againſt

againſt the Plague, whence it may alſo be made probable, that the Plague it ſelf many times is a natural, though a dreadfull and anomalous Diſeaſe, ſince its Effects and Symptomes ſo much reſemble thoſe of acknowledg'd Poiſons, and have been cur'd by Antidotes effectual againſt other Poiſons.

I have not time to mention what I have my ſelf try'd and obſerv'd about the bad effects of Orpiment, and its kinds. But I remember, that enquiring of an ingenious Man, who ſometimes viſited a Mine which was known to abound with Orpimental Foſſils; he anſwer'd me, that when he walked over the neighbouring Grounds, he found himſelf much diſorder'd, eſpecially in his *Thorax* by the *Effluvia*, and that the Mine-men and Diggers were ſubject to a malignant anomalous and dangerous ſort of Fevers, though he ſaid he was apt to impute, I know not how truly, ſome part of their obnoxiouſneſs

to

to it, to their drinking too much ſtrong Wine. But though 'tis probable the *Effluvia* of Orpimental Bodies may have a great intereſt in ſeveral Plagues, yet, I ſtrongly ſuſpect that many others may proceed from the ſteams of ſuch Subterraneal Bodies as are not yet diſtinctly known to us; and poſſibly have their *Effluvia* variouſly combin'd, either beneath or *above* the ſurface of the Earth. I ſay *above*; becauſe I have ſeveral times, and that without heat, combin'd ſeparately inviſible fumes of differing kinds, into manifeſtly viſible ones in the free and open Air.

And that the Subterraneal *Effluvia* may produce effects, and therefore probably be of natures, very uncommon, irregular, and if I may ſo ſpeak, extravagant, may appear in thoſe prodigious Croſſes that were ſeen in our time, *viz.* in the Year 1660. in the Kingdom of *Naples*, after an eruption of the fiery Mountain *Veſuvius*: of which Prodigies

digies the Learned *Kircherus* has given an account in a particular *Diatribe*. For these Crosses were seen on Linen Garments, as Shirt-sleeves, Womens Aprons, that had lain open to the Air, and upon the expos'd parts of Sheets; which is the less to be admired, because as *Kircher* fairly guesses, the mineral vapours were by the texture that belongs to Linen [which consists of threads crossing one another for the most part at or near right Angles] easily determin'd to run along in almost streight lines, crossing each other, and consequently to frame Spots resembling some one, and some another kind of Crosses. These were extremely *numerous* in several Parts of the Kingdom of *Naples*: insomuch that the Jesuit that sent the Relation to *Kircher* says that he himself found thirty in one Altar-cloth, that fifteen were found upon the Smock-sleeve of a Woman, and that he reckoned eight in a Boy's Band: also their *colour* and *magnitude* were

were very unequal, and their *figures* diſcrepant, as may appear in many Pictures of them drawn by the Relatour: they would not waſh out with ſimple water, but requir'd Soap; their *duration* was alſo unequal, ſome laſting ten or fifteen days, and others longer before they diſappear'd. And theſe Croſſes were found not onely upon Linen Garments expos'd to the Air, but upon ſome of thoſe (belonging to Altars) that were kept lock'd up in Cheſts (to which poſſibly they might have acceſs by the Key-holes, or ſome unheeded chinck.) To which ſtrange *Phænomena* if I had the leiſure to add ſome others that I have met with in *Agricola*, and other approved Authours, whoſe Relations my memory doth not now ſerve me particularly to cite; I preſume it would appear yet more probable that Subterraneal *Effluvia* may now and then be of a very Anomalous nature, and produce ſtrange effects, and among them variety

variety of Peſtiferous ones in the Air.

But, to add this upon the bye: though I fear Phyſicians will not be able to diſcover *all* the ſubterraneal Bodies whoſe *Effluvia* produce or contribute to the Plague: yet I do not think it impoſſible that by diligent obſervations and trials, ſagacious Men may diſcover *divers* of them; and perhaps Antidotes againſt them.

And though the buſineſs of this Paper be to treat of the Cauſes, not the Remedies of the Plague; yet I love Mankind too well, to ſuppreſs on this occaſion an Obſervation, that, by God's bleſſing, may in ſome caſes, ſave the lives of many. In the late great Plague that ſwept away ſo many thouſands at *London*, there ſtaid in the City an Ingenious Phyſician, that was bred by the Learned *Diemerbroeck*, (whoſe Book *De Peſte*, I prefer to any I have yet read of that Diſeaſe.) This Doctour (whoſe name I am

ſorry I have forgotten) hearing that I was deſirous to receive an account of the Plague from ſome intelligent Eye-witneſs, and having ſoon after ſome occaſion to paſs near the Place in the Countrey where I then reſided, was pleas'd to give me a viſit, and a rational account of the main things I deſired to know; and when I inquired about his method of Cure, after he had told me that he had twice had the Plague himſelf, whereof he ſhewed me ſome effects; he added, that after many and various trials, he perceiv'd that abundance of his Patients died, after the Bubos, (Carbuncles) or Peſtilential Tumours appear'd; becauſe upon a little refrigeration of the Body by the Air, and oftentimes by the very fear that diſheartened the Patient, the Tumours would ſuddenly ſubſide, and the Peſtilential Matter recoiling upon the Vital Parts, would quickly diſpatch the fatal work. Wherefore he bethought himſelf of a me-

a method, by means of which he aſſur'd me, he had not loſt one Patient of very many he treated; if he could but, as he uſually did, by good *Alexipharmical*, and Cordial Remedies, enable and excite Nature to expell the peccant Matter into a Tumour; for then he preſently clapp'd on an appropriated drawing Plaſter, which would never ſuffer the Tumour to ſubſide; but break it, or make it fit for opening, and thereby give Nature a convenient vent, at which to diſcharge the matter that oppreſs'd her. This Plaſter 'twill eaſily be thought I was deſirous to know; and he told me 'twas a Chymical one, and that 'twas no other than the *Magnes Arſenicalis* of *Angelus Sala*, whoſe deſcription, becauſe the Book wherein 'tis found, is in few hands, I have here annext. If this prove as ſucceſsfull in other Plagues, as it did to thoſe that us'd it in that of *London*; there will be juſt cauſe to admire and praiſe the benignity of Divine

Providence, which in a poiſonous Mineral, that probably does oftentimes concur to produce the Plague, has laid up a remedy for it.

Emplaſtrum attractivum Peſtilentiale noſtrum.

℞ *Gummi Sagapeni, Ammoniaci, Galbani an.* ℥iii. *Terebinthinæ coctæ, ceræ virginis ana* ℥ivß. *Magnetis Arſenicalis ſubtiliter pulveriſati* ℥ii. *radic' Aronis pulveriſat'* ℥i. *Gummi depurentur cum aceto ſcyllitico, & ad conſiſtentiam Emplaſtri coquantur, & poſtea ponderentur, deinde cum rebus aliis fiat Emplaſtrum lege artis, hoc Emplaſtro Carbunculus obducatur, quod paucis horis venenum extrahit.*

Præparatio Magnetis Arſenicalis antea dicti.

℞ *Arſenici Chryſtallini, ſulphuris vitri, antimonii crudi ana, hæc tria in mortario ferreo pulveriſentur, in vaſe fortiſ-*

fortiſſimo vitreo, ponantur ad ignem arenæ donec vitrum optimè incalcſcat, & prædicta ſolvantur & liquentur inſtar picis, quod obſervabitur quando filum quoddam immittitur in fundum quod extractum poſtea inſtar Terebinthinæ trahetur ubi ſatis coctum erit, poſtea remove vitrum ab igne, & ubi refrigeratum eſt rumpe, & ſubtiliter pulveriſa, & ad uſum ſerva.

By the ſame motive *(Philanthropy)* I am induc'd to add on this occaſion, that having had ſome opportunity to oblige an ancient and very experienc'd Phyſician, to whoſe care was committed a great Peſthouſe, where the Contagion was ſo ſtrong, that he loſt three Phyſicians that were to be Aſſiſtants to him, and three Chirurgeons of four that were to be ſubſervient to him; I deſir'd to learn of him, if he counted it not too great a ſecret, what Antidote he us'd to preſerve himſelf from ſo violent and fatal an Infection. This re-

queſt he readily granted, but withall told me, that his method would not ſeem to me worth mentioning, if I were one that valu'd Medicines by their Pompouſneſs, not their Utility. For, beſides ardent Prayers to God, and a very regular Diet, his conſtant Antidote was onely, to take every Morning faſting a little Sea-ſalt diſſolv'd in a few ſpoonfulls of fair Water; which he made choice of, both becauſe it kept his Body ſoluble without purging or weakning it, and for other Reaſons which I muſt not now ſtay to ſet down. I know this Medicine may appear a deſpicable one; but yet in my Opinion it ought not to be deſpis'd, after ſuch Experience as I have related has recommended it. For I think it deſirable, that notice be taken of all Remedies, that have been found by good Trials, not bare Conjectures or uncertain Reports, available againſt the Plague. For, ſince Peſtilences, as we have lately noted, are exceeding various

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in their kinds, 'tis very poſſible, and not unlikely, that their Appropriated Remedies may be ſo too. And therefore I would not eaſily lay aſide every Medicine, that this or that Learned Phyſician may ſpeak ſlightly of, or even may declare that he has found it unſucceſsfull againſt the Plague; ſince the ſame Medicine may be available in a Peſtilence of another kind, in which perhaps the Remedies commended by the Phyſician we ſpeak of, will be found inefficacious.

This Conſideration forbids me to paſs by what happen'd to me in the great *London* Plague above-mention'd; namely, that a very Learned Phyſician having once recommended to me an Herb little noted in *England*, as a moſt effectual and experienced Antidote againſt the Plague, I caus'd it to be cultivated in a Garden (as I ſtill do every year;) and when the Peſtilence raged moſt, having ſome of it by me, made up with a little Sugar in the

ſorm of a fine green Conſerve, I ſent it to two infected Perſons, who, by the Divine Benediction on it, both of them recover'd. But having made but thoſe two Trials, I dare not ground much upon them onely; though I uſually keep the Plant growing in a Garden, partly becauſe both the Taſte and Colour; one or other of which in moſt Antidotes is offenſive, are in this pleaſant; and partly becauſe ſome little Experience has invited me to believe the Commendations that I have found given of it, againſt the Bitings of venomous Creatures: whereof I remember a notable Inſtance is recorded by *Petrus Spehrerius* of a *Roman*, who having with his Staff pierc'd or cruſh'd a Viper, that he took to be dead, had ſo ſtrong a Venom tranſmitted along the Staff, that the inſuing Night he had a very great Inflammation in both his Lips, to which

In Obſervat. nobil. apud Schenkium, *l.* 7. *Obſerv. Med. Tit. de venenis ex animalibus.*

which ſuperven'd an exceeding Ardent Fever and ſtrange Tortures; from all which *Serianus Pacyonius*, a noted Phyſician that was call'd to him, free'd him as it were by Miracle, by the Juice of *Goats-rue*, or as others call it *Galega*, that grew copiouſly in that Place. It may without diſguſt be taken ſomewhat plentifully, (and ſo it ought to be) in its entire ſubſtance as a Salad; or elſe one may give its Conſerve, its Syrup, or, which is better, its Juice newly expreſs'd.

(3.) It likewiſe agrees with our *Hypotheſis*; that ſometimes the Plague ceaſes, or at leaſt very notably abates of its Infectiouſneſs and Malignity, in far leſs time than according to the wonted courſe of that ravenous Diſeaſe, Phyſicians did, or rationally could expect. For ſometimes it may happen, that, though the Temperature or Intemperateneſs of the Air continues the ſame, the matter that afforded the Peſtiferous Exhalations may be either

ther ſpent under ground, or ſo alter'd by combination with other ſubterraneal Bodies, or by ſome of thoſe many Accidents that may happen, altogether unknown to us, in thoſe deep and dark Receſſes. And if once the Fountain of theſe noxious *Effluvia* be ſtopt, ſo that thoſe that are in the Air ceaſe to be recruited, the Wind and other cauſes may in a ſhort time diſſipate them, or at leaſt dilute them with innocent Air, ſo far, as to keep the Diſeaſe they produc'd from being any thing near ſo miſchievous as before. And here I conſider, that it may ſeveral times happen, that, though the Minerals that emit the hurtfull Expirations, remain where they were under ground, and be not conſiderably waſted, yet their fatal Effects may not be laſting, becauſe the *Effluvia* were generated by the conflict of two or more of them, which vehemently agitated one another, and ſent up fumes, which ceas'd to aſcend, at leaſt in great plenty, when the

the Conflict and Agitation ceas'd. As, I have try'd that by putting good Spirit of Salt upon Filings of Steel or Iron in a conveniently ſhap'd Glaſs, there will be made a great conflict between them, and without the help of external Heat, there will be ſent up into the Air ſtore of viſible Fumes of a very Sulphureous Odour, and eaſily inflammable, which copious elevation of Fumes will leſſen or ceaſe, as does the tumultuous agitation that produc'd them. And ſo likewiſe, if you pour *Aqua fortis* upon a convenient proportion of Salt of Tartar, there will be at firſt a great ebullition produc'd, and, whilſt that continues, ſtore of red and noiſome Fumes will be elevated, but will not long outlaſt the commotion of the mixture, whoſe active parts will in no long time combine into a kind of nitrous Salt, wherein the noxious parts of the *Menſtruum* are as it were pinion'd, and hinder'd from evaporating or aſcending, though really they

they retain much of their priſtine nature, as I elſewhere ſhew.

It may alſo happen, that ſoon after that commotion of ſubterraneal Matter, which ſent forth peſtiferous Exhalations, a more intenſe degree of ſubterraneal Heat, or perhaps the ſame latent Fire, extending it ſelf farther and farther, may force up Fumes of another ſort, that being of a contrary nature, may be, if I may ſo ſpeak, antidotal againſt the former; and by precipitating them, or combining with them, may diſable them from acting ſo miſchievouſly as otherwiſe they would. To countenance which I ſhall tell you, that I have ſometimes purpoſely made Diſtillations, in which one part of the Matter being, after the operation ended, put to the other, there will enſue a ſudden and manifeſt conflict between them, and ſometimes an intenſe degree of Heat. And that mineral Exhalations, though otherwiſe not wholeſome, may diſable peſtiferous *Effluvia*,

via, may be gather'd from what I lately noted about a Countrey, which abounding with veins of Cinnabar, was, probably by their expirations, preſerved from the Peſtilence. And our *Hypotheſis* will perhaps appear ſomewhat the more probable, if we reflect on what I lately mention'd of the ſudden check, that is almoſt every Summer given to the Plague, which at that time is wont to reign at *Grand Cairo*. For ſince 'tis generally obſerv'd and complain'd of, that *Morbifick* Cauſes doe their work much more effectually than *Sanative* ones. It ſeems very probable that Exhalations aſcending from under-ground into the Atmoſphere, may be capable of producing peſtilential Fevers, and the Plague it ſelf, ſince thoſe Corpuſcles that impregnate the *Egyptian* Air upon the ſwelling of the Nile, are able to put a ſpeedy ſtop, not onely to the contagiouſneſs, but to the malignity of the Plague, even when 'tis aſſiſted by the Summer Heat,

Heat, which at *Grand Cairo* is wont to be exceſſive.

But having inſiſted perhaps too long on this *Egyptian* Peſtilence, I ſhall onely add, by way of Illuſtration of the Conjecture that invited me to mention it, that the acceſſion even of Expirations that are not themſelves wholſome, may ſometimes ſerve to correct the Air, and put a ſudden check to an Epidemical Diſeaſe. For Corpuſcles of differing kinds may by their Coalitions acquire new Qualities, and each ſort of them loſe ſome of thoſe they had before: as, ſuppoſe there wander'd in the Air a great many *Effluvia*, which by their determinate ſhape and bulk were apt to corrode or irritate the Lungs, or the Membranes of the Brain, *&c.* as thoſe of Nitre are to corrode Silver; it may happen that another ſort of Reeks, though in their own nature unwholſome, may, by aſſociating themſelves with the firſt ſort, and compoſing with them Curpuſcles of new

new qualities, abolish or much weaken the noxious ones they had before, in reference to this or that part of the Humane Body. Though the Spirits of Salt-peter will readily corrode Silver, yet if you add to them (as for some purposes I am wont to do) about half as much or less of the spirituous Particles of common Salt, (which yet are corrosive enough, and will fret asunder the parts of Iron, Copper, Antimony, &c.) there will emerge a Body that will not at all corrode pure Silver.

PROPOSITION IV.

'Tis very probable, that most of the Diseases that even Physicians call New ones, take cause either chiefly or concurrently by Subterraneal Steams.

THE Product of my first Endeavours to bring credit to the foregoing Proposition, appearing to have miscarry'd, when I came to send to the Press the things I had written about it; that at least what can be preserv'd of it may not be lost, I shall substitute in stead of it the following Account.

At the entrance of my Discourse I observ'd that the Term *new Disease* was much abused by the Vulgar, who are wont to give that Title to almost every Fever, that, in Autumn especially, varies a little in its Symptoms, or other Circumstances, from the Fevers of the foregoing Year

Year or Season. And therefore I declared, that by *new Diseases* I meant onely such, whose Symptoms were so uncommon, that Physicians themselves judged them to deserve that appellation; Such, for instance, as the *Sudor Anglicus* or Sweating Sickness; that Disease which the learned *Wierus* and others call in Dutch *Die Varen*; an unheard-of Disease describ'd by *Ronseius*, that in the Year 1581 invaded and destroy'd many in the Dukedom of *Lunenburg*; to which many Physicians add the Rickets, and others generally the *Lues Venerea*. Having clear'd the Terms, I next consider'd whether there were really any *new Diseases* properly so call'd, and gave some reasons to suspect that some Diseases, which among Physicians themselves have pass'd for *New*, were extant before *in rerum natura*, though not in the Countrey wherein even the learned judg'd them to be new. And I intimated, that to examine this Suspicion throughly, 'tis not safe

to acquiesce in the Books of Physicians onely; but 'tis fit to consult the Writings of Geographers, whether *ancient* (among whom I particularly recommended *Strabo*) or *Modern*, together with the Relations of Historians, Navigators and other Travellers. And here I inquired, without determining any thing, whether the *Lues Venerea* be, as most Physicians are wont to suppose a Disease wholly new, or onely new to our European World, and brought hither from some African or other remote Region, where it may be probably suspected to have long been Endemical.

But taking it for granted, with the generality of Physicians, that some new Diseases are to be admitted; I advanced to consider some of the Causes, to which they may be imputed; And to give some reasons, why I do'nt acquiesce in their Opinion, though very general, that derive them onely or chiefly from the varying influences of the Heavenly Bodies.

Bodies. For the moſt powerfull of thoſe, namely the Sun and Moon, act in too general and indeterminate a way, to afford a ſufficient account of this affair. And as for the other Lights, the fixt Stars, beſides their being univerſal and indefinite agents, their ſcarce meaſurable remoteneſs makes it juſtly queſtionable, whether they have any ſenſible Operation upon any part of our Bodies, ſave our Eyes. And, *though* I deny not that great intemperateneſs of the Air, as to the four firſt Qualities, as Heat, Cold, Drineſs and Moiſture, are wont (not over juſtly) to be call'd, may diſpoſe mens Bodies to ſeveral great Diſtempers, and may alſo be concurrent cauſes of thoſe we are ſpeaking of; *yet* neither can I acquieſce in theſe, when I conſider how much more frequently they happen, than new Diſeaſes do; and that their action, though various, is too general and indeterminate to perſwade me, that they can be the adequate cauſes of effects ſo rare and

anomalous, as Diſeaſes odd enough to deſerve the Title of new.

But now; the Subterranean Region of our Globe, beſides that it is always near us, abounds with variety of noxious Minerals, and probably conceals great quantities of differing ſorts of them, that are yet unknown to us. And ſince we have elſewhere proved, that there want not cauſes in the Bowels of the Earth, to make great and irregular, and Sometimes ſudden Confluxes, Conflicts, Diſſipations, and other conſiderable Changes, amongſt the Materials, that nature has plentifully treaſured up in thoſe her ſecret Magazins. And ſince, in making out the three former Propoſitions, we have manifeſted, that the Subterraneal parts of the Globe we inhabit, may plentifully ſend up Noxious *Effluvia* of ſeveral kinds into the Air; it ought not to ſeem improbable that among this Emergent variety of Exotick and hurtfull Steams,

A Diſcourſe of Subterraneal Steams as they affect the Air.

Steams, ſome may be found capable to diſaffect Humane Bodies, after a very uncommon way, and thereby to produce *new Diſeaſes*; whoſe duration may be greater or ſmaller, according to the laſtingneſs of thoſe Subterraneal cauſes, that produce them. On which account it need be no wonder, that ſome new Diſeaſes have but a ſhort duration, and vaniſh not long after, there appearing the Source or *Fomes* of the Morbifick *Effluvia*, being ſoon deſtroy'd, or ſpent: whereas ſome others may continue longer upon the Stage, as having under ground more ſettled and durable cauſes to maintain them. Which laſt part of the Obſervation may be illuſtrated by what happen'd in *Calabria*; which Province, though it have been obſerved to have acquired, within theſe two or three ages, the faculty of producing *Manna* upon certain Trees *; yet this great change, though ſudden enough, had

* C. Magnenus *de Manna, cap.* 9. *Dicamabo*, Altomari, *cui ante trecentos annos nullum Manna fuit in Oenotria; jam cer-*

et adeam Pagi ibidem urbisque vicina neque fefellisset curiosam Incolarum solertiam. &c. ita, ante 240. annos nullum Mimne Calabrensis in Autoribus vestigium est.

it seems such stable causes, as well as of great extent, that it hath lasted several scores of years, and continues in that Countrey to this day.

I am not ignorant that the whole Doctrine propounded in the four Propositions about the Insalubrity of the Air, is not at all comfortable either to Patients or Physicians: But important Theories deserv'd to be inquir'd into, and, if true, to be deliver'd though we could wish they were untrue. And judicious men rather thank than blame those that have given us account of latent or unsuspected, though perhaps irremediable causes of Diseases and of death; or have recorded the Histories of some Poysons, whereof the true Antidotes are yet unknown. Uncommon Notions about Diseases may serve to inlarge the Physicians mind and excite his attention and curiosity: and, besides that they may keep

him

him from too obſtinately perſiſting in the uſe of receiv'd Medicins, though unſucceſsfull, upon a Suppoſition that the Diſeaſe can have no other cauſes, than thoſe wont to be aſſign'd it by Claſſick Authours: beſides this, I ſay; I do not deſpair, but that either the ſagacity or fortune of this inquiſitive age, or at leaſt of Poſterity, may by the bleſſing of God be happy enough to find proper Remedies, even for thoſe Diſeaſes that proceed from Subterranean *Effluvia*, when once by proper Signs they ſhall be diſtinctly diſcover'd; (Of which power of appropriated Remedies) I have known ſome Inſtances, as to the very bad Symptoms produc'd by Antimonial and ſome other Mineral Fumes.

Some of the Points diſcours'd of under the fourth Propoſition, were of affinity enough to Paradoxes to have need of being illuſtrated or confirmed by Obſervations and Experiments. And therefore having accidentally retriev'd ſome of this laſt

laſt nam'd ſort, I ſhall venture to ſubjoin them as a *Specimen*, though without Tranſitions or Applications, but juſt as I found them thrown together, in one looſe ſheet, wherein I lighted on them. But it is time to conclude with the recital of the promiſed Experiments. Which I would immediately do, but that I hold it fit to premiſe, by way of Introduction to them, that I hope the Things hitherto diſcours'd will appear much the more probable, if we ſhall prove by Experiments, that which ſeems much leſs likely than any thing we have above deliver'd; namely, that Metals completely formed and malleable may be elevated into the Air, and that perhaps without any great violence of Fire, in the form of Exhalations and Vapours; the ſingly inviſible Corpuſcles ſtill retaining their Metalline nature. This at leaſt, as to ſome Metals, I have endeavour'd to prove in another Tract, [entitl'd *a Paradox about the Fuel of Flames.*] But becauſe that Diſ-

Diſcourſe was never publiſh'd I will here ſet down two or three Experiments, (not mention'd, that I remember in it.) Which I do, the more willingly, becauſe it may be a Thing of no ſmall moment in Phyſick, if it be ſhewn that Fixt and ſolid Bodies, ſuch as Metals are, may by art be reduc'd into ſuch minute Corpuſcles, that without looſing their nature and all their Properties, they may become parts of Fumes, or perhaps of inviſible Vapours, or even of Flame it ſelf.

Particulars belonging to the IVth *Propoſition.*

EXPER. I.

WE took three Parts or Pounds of *Dantſic Vitriol* (which is blew and ſomewhat partakes of *Copper*) and two Parts or Pounds of good *Sea-ſalt*; theſe being very well pow-

powder'd and mix'd were distill'd with a strong naked Fire, to force out all that could be driven over: and by this means we not onely obtain'd a Spirit of Salt of a manifestly blewish Colour, but there ascended also a considerable quantity of *Powder*, which being shaken with the Liquor, settled at the bottom of it in the form of a Powder, which was judg'd to consist of Corpuscles of a *Cupreous* nature, and perhaps also of some of a *Martial* nature. But I unhappily neglected the opportunity of examining this Powder, which came up in quantity enough to have serv'd for various Trials.

EXPER. II.

By substituting *English Vitriol* (which is green, and is much more abundant in *Iron* than that of *Dantsic*,) and proceeding in other respects as in the former Process, we obtain'd a very yellow Spirit, with a con-

a conſiderable quantity of a yellowiſh Powder, that was gueſs'd to be a kind of *Crocus Martis*.

EXPER. III.

We took very thin Plates of *Copper*, and caſt them into a Retort, upon an equal or a double weight (for we did not always uſe the ſame) of good *Mercury Sublimate*; and luting on the Receiver, gave a Fire by degrees for ſeveral hours: by which means we uſually obtain'd ſome running Mercury, (which ſeemed to be very well purifi'd and was perhaps alſo impregnated) together with ſome Sublimate that had not faſten'd upon the Copper. And at the bottom of the Retort we had good ſtore of a ponderous and brittle ſubſtance, that did not look at all like a Metal, but rather like ſomething of a Gummous or Reſinous nature, being alſo fuſible and inflammable almoſt like ſealing Wax. This, having not opportunity to pro-

proſecute the Experiment at home, I put into the hands of an induſtrious Phyſician, that was earneſt with me to impart to him the Proceſs, and let Him purſue it for me. He according to my direction expos'd this *Metalline Roſin* (if I may ſo call it) groſsly beaten to the free Air, where it did, according to Expectation, in a ſhort time change Colour, and turn to a kind of *Verdegreece*: which being diſſolv'd in good Spirit of Salt gave a Solution of a very lovely green Colour. This being ſlowly diſtill'd *ad Siccitatem*, yielded but a very weak and phlegmatick Liquour; and the *Caput Mortuum* was again diſſolv'd in freſh Spirit, and the *Menſtruum* abſtracted as before. This was done ſeveral times, till the matter was ſo impregnated, that the *Menſtruum* being drawn off from it, came over as ſtrong almoſt as when it was put on. This done, the thus impregnated *Verdegreece* was diligently mingl'd with *Tripoly*, or ſome ſuch inſipid and fixt additament, and

and diſtill'd with a ſtrong Fire; by which means it afforded good ſtore of a Liquour Colourleſs like common Water: which made the Phyſitian ſuppoſe the Experiment had miſcarry'd, till I having dropt into it a Colourleſs Liquor, namely Spirit of Hartshorn or of Sal-armoniac; He was much and delightfully ſurpriz'd, to find it preſently diſcloſe a deep and lovely blew Colour. What afterwards became of this odd Spirit, I need not here declare; what has been ſaid being ſufficient, to ſhew that Corpuſcles of Copper may be elevated in the form of Exhalations both transparent and Colourleſs. The next following Experiment though in part mention'd by ſome Chymiſt is here ſubjoin'd, becauſe it's neceſſary and applied to a particular purpoſe.

EXPER.

EXPER. IV.

If from good *Cornish Tin* you warily distill an equal or double weight of Venetian *Sublimate*, into a very large Receiver very well luted on to the Retort, you will obtain a spirituous Liquor, which as soon as the free Air comes to touch it, will send up abundance of white Exhalations in the form of a thick Smoak, which will continue to be emitted much longer than one would imagine. But that which I desire to have particularly observ'd in this Experiment is, that though this Liquor be thus apt to emit Smoak, not onely plentifully, but as one would think with Violence, yet I found by Trial, that even when I put it into a Vessel not strait mouth'd, if I did but lay a piece of a single leaf of Paper flatwise upon the Orifice of the Glass, so as to cover it all, the visible production of the Fumes would presently cease; and the Liquor would lie like

like common Water, as long as the Paper lay, though but lightly upon the Glaſs; though upon the Removal of that, the Liquor would ſend up plentifull Fumes as before, which ſeems to argue, that ſome Metalline Subſtances may, by the contact of the *Air*, have their Copious aſcenſion into the Atmoſphere very much help'd and promoted, as if the *Air* had Saline or other ſort of Particles in it, that are in reference to ſome Mineral Bodies of a very volatilizing nature. The way by which I have divers times elevated the Fixedſt of Metals, *Gold* it ſelf, I have deliver'd in another Paper, and ſhall not here repeat it. But I ſhall now ſet down an Experiment that when it is carefully made, is eaſie to be perform'd, and yet affords a notable and ſenſible Proof, that the Corpuſcles of a Metal may be made to aſcend, and that plentifully, even with a very moderate Heat, under the form of ordinary Fumes or Smoak.

To effect this I devis'd the following Experiment.

We took *Copper* and diſſolv'd it in good *Aquâ fortis*, till the *Menſtruum* was ſatiated with it, in the ſtrong Solution we ſteep'd a while ſome brown or other porous Paper, that being fitter than the finer, to ſoak up the *Menſtruum*; then ſlowly evaporating the ſuperfluous moiſture, we put a quantity of this imperfectly dry'd Paper upon the Hearth, at ſuch a diſtance from a Fire of actually flaming Wood that the Paper was not kindled, but yet was ſo ſcorch'd, as to afford very plentifull Fumes: theſe look'd like ordinary Smoak, whilſt they mov'd through the Air, and would queſtionleſs have mingl'd with it, and been diſpers'd through it, if the Body that emitted them had not been purpoſely plac'd for a future deſign. But when the motion of the Air towards the Flame had carry'd theſe Fumes

to

to it, the Metalline Smoak did, as I expected, disclose its nature; for being actually kindled, it ting'd the Flame of a lovely Colour, for the most part Blew, and sometimes Green, as it happen'd to be variously mix'd with the Flame and Smoak of the Wood.

THE END.

A

Short Supplement

TO THE

ESSAY

OF THE

GREAT EFFECTS

OF

Even *Languid* and *Unheeded*

LOCAL MOTION.

THAT I may not be altogether wanting to the Expectation that may have been rais'd, by a Paſſage in the Advertiſement prefix'd to the foregoing Eſſay; I ſhall here ſubjoin ſome Particulars, which perhaps will not be unwelcome to the Readers, that occurr'd to my remembrance, whilſt I was,

with a tranſient Eye, reviewing the Heads of the paſt Diſcourſe. But theſe *Paralipomena* or Supplements will be but few, not onely becauſe of my want of leaſure to review the Tract they belong to deliberately, but alſo becauſe ſome Inſtances, that might be here ſubjoin'd, may be more opportunely brought in in other Papers.

To the IIId. Chapter.

THAT the Motion of the Air that accompanies Sounds may be propagated to great Diſtances, and yet make conſiderable Impreſſions on the Bodies it finds there, diſpos'd to admit its Action, may be notably confirm'd, by a *Phænomenon* I have met with, in the learned Mathematician *Borellus*, who relates it upon his own knowledge, and not undeſervedly magnifies it: which I ſhall therefore recite in his own

own Words. "*Aderam* "(ſays he) *Tauromenii* "*Siciliæ, quando Ætna* "*mons eruptionem quandam effecerat* "*propè Ennam, urbem fere* 30. *Mil-* "*liaria à Tauromenio diſtantem, tunc* "*vicibus interpolatis eruptiones in-* "*gentes ignis vorago efficiebat, grandi* "*ſono & ſtrepitu, & tunc omnia Tau-* "*romenii ædificia, tremore concutie-* "*bantur, in quo Circumſtantiam no-* "*tatu digniſſimam obſervavi: ſcili-* "*cet, quòd domus & ædificia quæ di-* "*rectè expoſita erant proſpectui ejuſ-* "*dem voraginis, vehementiſſimè con-* "*cutiebantur; reliquæ verò domus,* "*quæ conſpectu voraginis privaban-* "*tur, ſatis lentè & leniter tremorem* "*efficiebant.* Upon which matter of fact he thus argues: "*Profectò, ſi* "*hujuſmodi tremor factus fuiſſet à* "*concuſſione & reſilitione ſoli Tauro-* "*menitani, omnes domus æquè con-* "*cuſſæ fuiſſent, & æquali tremore* "*agitatæ, ita ut non poſſit conſpectus* "*voraginis tam inſignem & eviden-* "*tem inæqualitatem tremoris pro-*

Borel. *de vi Percuſſionis. Prop.* CXI.

" *creare; igitur neceſſariò à tremore*
" *ejuſdem aëris incuſſo in parietibus*
" *domorum liberè percuſſiones excipi-*
" *entum, agitatio illa efficiebatur. Vi-*
" *deas hinc,* (infers he) *quanta ſoni*
" *ad* 30 *milliarium diſtantiam effi-*
" *cacia ſit.*

To the Vth. Chapter.

THAT Motion may be propagated far, through Bodies of differing Natures, may be inferr'd from what is mention'd in this Chapter, eſpecially about Earthquakes. But becauſe it may reaſonably be ſuſpected, that the Active Matter which produces thoſe ſtupendious Motions, is diſpers'd into divers Places, and may be of conſiderable Extent, I ſhall here ſubjoin, out of the Eloquent *Famianus Strada*, an Inſtance, which is much the moſt memorable to my purpoſe that I remember to have met with in Hiſtory;

tory; to manifeſt to how great an extent a Motion excited in a very narrow compaſs, perhaps but a very few fathom ſquare, may be propagated through differing *Mediums*, and one of them as ſolid as Earth. This famous Hiſtorian then, having deſcrib'd a ſtupendious Work, that had been with great skill and care made by the *Prince of Parma*, to keep the City of *Antwerp*, which he cloſely beſieged, from being reliev'd by the River *Scheldt* (which, though not broad, is deep) proceeds to relate, that an *Engineer*, who was a great Maſter in his Art, having undertaken to deſtroy this great Work with a Veſſel (which I think we may call a *Floating Mine*) fraught with Gunpowder, Fireworks, *&c.* perform'd it with ſo tragical a ſucceſs, that ſome Spaniſh Officers that were preſent, reckon'd 800. to have been kill'd outright, beſides a great number that were wounded and maim'd. But that Part of the Narrative which comes home to our pre-

ſent purpoſe, is deliver'd in theſe Words.

Famian. Strad. *de Bello Belg. Dec. 2. lib. 6, vel 7.*

On a ſudden the fatal Ship burſt, with ſuch a horrid craſh, as if the very Sky had rent aſunder, Heaven and Earth had charg'd one another, and the whole Machine of the Earth it ſelf had quaked. For the Storm of Stones, Chains and Bullets being caſt out with Thunder and Lightning, there followed ſuch a Slaughter, as no man, but that actually it happen'd, could have imagin'd. The Caſtle on which the Infernal Ship fell, the Pile-work of the Bridge to St. *Mary*'s Fort, that part of the Naval Bridge next the Caſtle, Souldiers, Mariners, Commanders, a great number of Cannons, Armour and Arms; all theſe this furious Whirlwind ſwept away together, toſſed in the Air, and diſperſt as Wind doth Leaves of Trees. The *Scheldt* prodigiouſly gaping was firſt ſeen to diſcover its bottom, then ſwelling above the Banks, was even with

with the Rampiers, and overflowed *St. Mary's* Fort above a foot. The motion of the panting Earth *N. B.* extended its force and fear above nine Miles. [If he means the Miles of that Countrey, or Dutch Leagues, they amount to 36 Engliſh Miles.] There were found Stones, and that very great ones, as Grave-ſtones, and the like, a Mile off the River, ſtruck into the Ground, in ſome places four Palms.

To the VIth. Chapter.

Obſervation I.

WHAT is delivered in this Chapter about the Operation of Sounds and Animals, particularly that which is mention'd *(Pag. 72.)* about the Effect of Muſick upon Serpents at *Grand Cairo*, may be not onely confirm'd but exceeded, by a ſtrange Relation that I had from a Perſon of unſuſpected Credit.

Which Narrative having appear'd to me ſo conſiderable, as well to deſerve a place among my *Adverſaria*, I ſhall ſubjoin that part of it which concerns our preſent Subject, in the words wherein I find it ſet down.

Sir *J. C.* a very candid and judicious Traveller, favouring me yeſterday with a viſit, told me among other remarkable things relating to the *Eaſt Indies*, (which Countries He had curiouſly viſited) that He with divers European Merchants had ſeen, (and that if I miſtake not, ſeveral times) an Indian, who by many was thought to be a Magician, that kept tame Serpents of a great bulk. And that when the Owner of them plaid upon a Muſical Inſtrument, theſe Serpents would raiſe themſelves upright into the Air, leaving upon the Ground but 3 or 4 Inches of their Tail, upon which they lean'd for their ſupport. He added, that at the ſame time that they erected their Bodies, they alſo ſtretcht

and

and lengthen'd them in a ſtrange and frightfull manner; and whilſt they were thus ſlender, they were taller than He or any man of ordinary ſtature. But that which appear'd to Him the moſt wonderfull and ſurpriſing, was, that they manifeſtly ſeem'd to be very much affected with the Muſick they heard; inſomuch that ſome Parts of the Tune would make them move to and fro with a ſurpriſing agility, and ſome other Parts of it would caſt them into a Poſture, wherein they ſeem'd to be half aſleep, and as it were to melt away with pleaſure.

To the VIth. Chapter. Pag. 75.

Obſervation II.

BEcauſe the Truth even of the principal effects of the Biting of the *Tarantula*, has of late been publickly call'd in queſtion, I was glad to meet with an ingenious Traveller, that

that in *Calabria* or *Apulia* was Himſelf bitten by one of thoſe venomous Inſects; and though it were but ſlightly, yet the Effects He felt in His own Body, and thoſe greater ones He ſaw produc'd in other Perſons, that were more unhappily bitten, brought Credit to the main of what ſober Writers affirm of the Symptoms and Cure of that Poyſon. And the learned, *&c.*

To the VIIth. Chapter. Pag. 83.

MUCH of what is delivered in this Chapter and elſewhere, about the Operation of Air or inviſible Fluids (whoſe Motions affect not the Touch) upon Congruous Solids, may be confirm'd by that notable Experiment, which has been publiſhed in an Elegant Diſcourſe by the learned *Morhofius*; about a Dutch Wine Seller in *Amſterdam*, by name *Nicolaus Petterus*, who, having found the Tone or Note peculiarly belong-

belonging to a large belly'd drinking Glass, Such as the Dutch call *Römer*, and many here call *Rhenish Wine Glasses*, would, by accommodating his voice exactly to that Tone, and yet making it loud and lasting, make the Vessel, though not visibly touched, first tremble and then burst; which it would not do, if the Voice were, though but a little, too low or too high. This notable Experiment has been seen by many *Vertuosi*, both before and since he publish'd it. And the very ingenious Writer, as he past through *London*, not onely related it to me, but very civily offer'd me farther satisfaction, if I could furnish Him with a *Römer*, which I was very sorry that where we then were was not to be procur'd.

To the VIIIth. Chapter.

Obſervation I.

IT may add probability to ſome things deliver'd in this Chapter and in divers other Paſſages of this Treatiſe, if I here recount a ſtrange *Phænomenon*, that came into my memory whilſt I was running over thoſe Parts of this Diſcourſe.

The *Phænomenon*, in ſhort, was this. Having met with divers pieces of tranſparent Glaſs, which I had reaſon to think to be of a Texture or Temper very differing from ordinary Glaſs, I thought fit to try, whether ſome of them were not far more ſpringy and brittle than their thickneſs would make one expect. And accordingly, though I found ſeveral wherein the Experiment would not ſucceed, eſpecially if their figure were not convenient, yet with ſome others, I had very good ſucceſs, and par-

particularly with ſome that were ſhap'd almoſt like the ſharper End of the neck of a Retort. For though theſe pieces of Glaſs were much thicker than ſuch necks are wont to be, being perhaps 6 or 7 times as thick as common drinking Glaſſes, yet I more than once made the Tryal ſucceed ſo well, that, by obliquely ſcratching them, or tickling them if I may ſo ſpeak, on the inſide with the head or point of a Pin, they would forceably burſt into many pieces in my hand. In which ſurprizing *Phænomenon*, the matter of the Glaſs ſeem'd to contribute ſomething to this odd Effect, of ſo languid a motion, but much leſs than the Texture, or Tenſion, it obtain'd by the peculiar way of ordering it in the Fire and the Air.

To the VIIIth. Chapter.

Obſervation II.

TO ſhew that the Suſpicion I mention my ſelf, a little before the end of this Chapter, to have had, that the breaking of the Stones there ſpoken of might poſſibly be produc'd or promoted by ſome impreſſions, remaining after the ſtrokes employ'd to force the Stones out of their Beds, was not altogether without ground.

I ſhall here obſerve, that it need not ſeem incredible, that faint ſtrokes and attritions may leave more laſting and operative Motions among the Inſenſible Parts, even of compact and ſolid Bodies, than one would readily imagine. For I have ſeveral times found, ſometimes by Obſervations deſignedly made, and ſometimes by undeſigned Accidents, that, having caus'd ſomewhat thin Veſſels of Glaſs, eſpecially Urinals, to be diligently

ligently made clean with Sand mixt with Water, to looſen or grate off the foulneſs that adher'd to the ſides of the Veſſel; though the Veſſels, after having been thus made clean, did not appear to have receiv'd the leaſt injury, and would continue very intire perhaps for ſeveral hours, yet after that time they would of themſelves break with noiſe, and thereby become unſerviceable for the future. But though this happen'd to many Urinals, yet, becauſe to more others it did not, it ſeem'd probable that the diſſilition depended chiefly upon the peculiar texture of the Glaſs in this or that Veſſel, whether acquir'd by a mixture of the Ingredients, that was not uniform enough or made in a due proportion; or elſe by the too haſty refrigeration of the Veſſel, eſpecially if it chanc'd, as is not very unuſual, to be cool'd more haſtily in one part than another.

To the IXth. Chapter. Pag. 110.

Obſervation I.

BEcauſe there are divers Gems, particularly thoſe Tranſparent ones that are Red or Blew, that are much harder than Iron or ſteel, it may much ſtrengthen the Proof of our 8th Obſervation, if I here relate that a Jeweller to a great Princeſs anſwer'd me, that when he poliſh'd Saphyrs, Rubies, and ſome ſorts of other hard Gems, upon his Mill, they would ſeem when attrition had made them very hot, to be all on Fire, like ſo many little Coals: And that each of them had the light it afforded ting'd with a Colour proper to the Stone; ſo that the Ruby gave a Red Light, the Saphyr a Blew, *&c.* And I remember that inquiring of a skilfull Cutter of Diamonds and Poliſher of Gems, whoſe Cuſtomer I had been, about ſome Conjectures I had concerning things belonging to his Profeſſion, he anſwer'd

anſwer'd me that ſometimes, when he poliſh'd certain Stones, eſpecially Rubies, that were pretty large and perhaps not thick, he could plainly perceive that the Stone gap'd at and near the Edge, as if it were begun to be crack'd; which ſign admoniſhed him to make haſte to ſlacken the Motion of the Mill, leſt the Stone ſhould abſolutely burſt; which if it did not he could not perceive any Flaw in it when it was throughly cold, but, which was ſtrange, it appear'd as entire as ever. He added, in confirmation of what he had ſaid of the intenſe Heat that Gems would ſometimes acquire by Attrition, whilſt they were in poliſhing, that having lately given by this means too great a degree of Heat, to an Oriental Topaz (which ſort of that Gem is very hard,) it crack'd upon the Mill, in ſo much that one part of it quite ſeparated from the reſt, and ſpoil'd the Stone in the capacity of a Gem; as a Proof whereof he had laid it aſide for me, and would needs make me accept it, as

a curious, though not an uſefull, thing.

To the IXth Chapter.

Obſervation II.

TO confirm what has been ſaid in the 8th Obſervation, to ſhew that ſlow and inſenſible Inteſtine Motions of the Parts of a Body that ſeem quieſcent, may be very operative, chance afforded me a notable Inſtance, which was this. I had, to preſerve a Liquor from which I expected a curious Experiment, inclos'd it in a ſtrong Vial, to whoſe neck a thick Glaſs Stople was but too exquiſitely adapted. This Veſſel I ſet upon the Edge of a Window, in a high and ſecure place, that it might not be mov'd. There it continu'd many Months, or, if I miſremember not, above a Year. And the Liquor was of ſuch a nature, that if any Body had, though but for a few Moments,

taken

taken out the Stople, I could eaſily diſcover it. But after all this while, one day that I was ſitting in my Cloſet, at a good diſtance from the place in which the Vial ſtood, I heard a loud and brisk noiſe, almoſt like the report of a Piſtol, and then perceiv'd that ſomething came rolling to my Feet: I haſtily took it up, and, found it to be the thicker and larger part of the Stople of my Vial, which of it ſelf had flown off, leaving the remaining part ſo cloſely and ſtrongly adjuſted to the Neck, which ſerv'd it for a kind of Socket, that I could by no means pull it out thence. At this Accident I was not a little ſurpriz'd, conſidering the thickneſs of the Solid Glaſs, and that it had ſtood ſo long unmov'd, and that the bigger and heavier part of the Stople broke off from the other with ſuch violence, and was carry'd from it by inviſible motors to ſo great a diſtance. Which ſeem'd the more ſtrange, becauſe there was no ſhaking nor treading in the Room, that

could put the parts of the Glaſs into Motion, there being no Body preſent but my ſelf, who was ſitting quietly and ſtudying.

To the IXth Chapter.

Obſervation III.

TO confirm what I have in the eighth Obſervation and elſewhere deliver'd about the latent Motion of Parts that may be in a Body not onely quieſcent but ſolid, I ſhall here add a ſtrange Inſtance, which was afforded me by a Diamond, belonging to an ingenious Merchant of that ſort of Gems, who brought many fine ones out of the *Eaſt Indies*. For having at the Diamond-Mine it ſelf, purchas'd amongſt other Stones that grew there, a rough Diamond that he valued at about a hundred pound, and had well conſidered when he bought it; coming to look over his purchaſe again once more,

more, about Ten Days or a Fortnight after, he was much ſurpriz'd to find, to his great loſs, that this Diamond had of it ſelf crack'd in ſeveral places, and ſo became of little or no value, but as 'twas a Rarity: and indeed I could not without wonder, ſee ſo fair and hard a Stone ſo oddly ſpoil'd with Clefts, that ſeem'd to penetrate ſo very deep, that 'twas gueſs'd 'twould not be very difficult to pull the parts of the Stone aſunder. And on this occaſion he told me, that he had admir'd this Accident at firſt, much more than he did afterwards. For complaining of it to divers Merchants and Jewellers, that he met with in thoſe Parts; he was told, that, though it ſeldom happen, yet 'twas no ſuch wonderfull Accident; The like misfortune having befallen others as well as him.

A Postscript.

THAT every common Reader may understand whatever is contain'd in the foregoing Treatises, the Publisher thought fit to english the Latin Passages that are not translated by the Authour.

I.

Tract I. Page 21.

Simon Pauli, *in his ingenious Treatise of Pestilential Fevers, p. 71. tells us of a sick Frenchman, who liv'd several days after his Arm was cut off, though he was all the while most cruelly tortur'd by not ordinary Convul-*

ſion Fits : But what is moſt obſervable is this that I and others ſitting one day by his Bed-ſide, but not taking notice that the great Guns were going off from the King's Ships, he laying hold, and cheriſhing the Stump of his Right Arm, broke out at every ſhot into theſe pitifull words : Jeſus Maria, *What do I not ſuffer ! I am quite bruis'd ; ſo troubleſome, and inſufferable to him was the ſhooting of the great Guns, though at a great diſtance, they being fired not in a joining Continent, but on the* Balthick-ſea.

II.

Platerus *in the Firſt Book of his Obſervations, p.* 185. *gives us this following Account, p.* 26.

A Woman being fallen ſick on a ſudden complain'd continually of her being ſtrangled, though there was no great appearance thereof ; this ſhe aſcribed chiefly to a certain Air, or Wind, which ſhe was ſo ſenſible of, that

that if any Body happen'd to come near her, ſhe would immediately complain of her being choak'd, and died the ſecond day of this odd Diſtemper: To which he adds, I have known ſeveral others complain of a not unlike Wind, and that they were in danger of being choak'd, if any body came near 'em: which I conceiv'd always to be a very ill ſign.

III.

Page 57.

If you throw down an Animal into the hole of Viburg, *which is in* Carelia, *a Countrey in* Scandia, *'tis reported that there breaketh immediately forth a great and inſufferable ſound, together with a ſtrong wind: if a ſmall weight be thrown into the Gap of* Dalmatia, *though, ſays* Plinius, *in a calm day, there is a ſtorm immediately rais'd not unlike that which is occaſion'd by a Whirlwind.* Agricola de Natura eorum quæ effl. è terra, l. 4. c. 7.

IV.

IV.

Page 67.

I diſcharg'd a Piſtol, being upon the top of the Hill, which at firſt made no greater noiſe than that which uſually happens at the breaking of a ſmall Rod: but after a little while the noiſe became ſtronger, and filled the lower parts of the Hill, the Valleys, and neighbouring Woods. Now coming down lower through Snow that had lain there ſeveral years, and having diſcharg'd again the Piſtol, the noiſe became on a ſudden louder than that of the greateſt Guns. Which gave me ſome grounds to fear that the whole Hill, being thus ſhaken, ſhould at length ſubſide: this ſound laſted half a quarter of an hour, till it had penetrated into the remoteſt Grotto's, whence the parts of the Air thruſting one another had been ſtrongly reverberated: and becauſe no ſuch concavities were in the top of the Hill, the ſound was firſt inſenſibly reverberated, till coming

coming lower and nearer the Grotto's and Valleys it was ſtrongly daſh'd againſt 'em.

V.

Tract II. Page 48.

'Tis worthy our admiration, ſays Beguinus, *that though in the Neighbourhood of* Hydria, *in the Countrey of* Gloricia, *where a great quantity of* Mercury *is found, the Peſt almoſt every year rageth, yet it is always free from the Plague: and this was confirm'd to me by Perſons of a very great Age, who ſaid they had receiv'd it from their Anceſtours.*

VI.

An Attractive Peſtilential Plaſter. Page 84.

Take of the Gums Sagapen, Ammoniac, Galbanum *three ounces, of boil'd* Turpentine, *and* Virgin-wax *four ounces, and a half, of the* Arſenical Loadſtone *well pulveriz'd two ounces,*

ounces, of Arons Root *pulveris'd an ounce; let the Gums be depurated with the Vinegar of* Squills, *and boil'd to the consistency of a Plaster, and lastly weigh'd; then according to the usual method with other things make up a Plaster: cover the Carbuncle with this Plaster, and in a few hours it will draw out all the venom.*

The true Preparation of the forementionʼd *Arsenical Loadstone.*

Take equal parts of Crystal-arsenick, *of* Sulphur of Glass, *of* Crude Antimony: *bray them to powder in an Iron Mortar, set them in a strong Glass on a fire of Sand, till the Glass be very hot, and the forementionʼd Druggs melted like Pitch: which you shall know when having thrust a Thred into the bottom, the matter sticking to it does rope like* Turpentine; *which is a sign of its being well enough boilʼd: remove then the Glass from the fire, and when it is cold break it; reduce the*

the matter into ſmall powder, and keep it for your uſe.

A Paſſage belonging to the Supplement.

Borel. de vi percuſſionis prop. CXI. *has theſe obſervable words. I was at* Tauromenium *in* Sicily *when the Mountain of* Ætna *broke out near* Enna, *a Town diſtant about thirty miles from* Tauromenium; *whilſt the Gap did ſend out now and then with a great noiſe fire and flame all the Houſes of* Tauromenium *were ſenſibly ſhaken: and it was obſervable that ſuch Houſes as look'd directly towards the Gap, were moſt of all agitated. Thoſe that look'd otherwiſe ſhaking more ſlowly, upon which matter of fact he argues thus: had this trembling been occaſion'd by the ſhaking of the Ground of* Tauromenium, *all the Houſes had been equally ſhak'd, ſince this inequality of motion could not be aſcrib'd to their different ſituation. Hence then*

we

we muſt needs conclude that this agitation was produc'd by the impreſſion of the Air upon the Walls of the Houſes, which demonſtrates to us the great efficacy of a ſound, though at thirty miles diſtance.

MVSEVM
BRITAN
NICVM